ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

JUNE 1956

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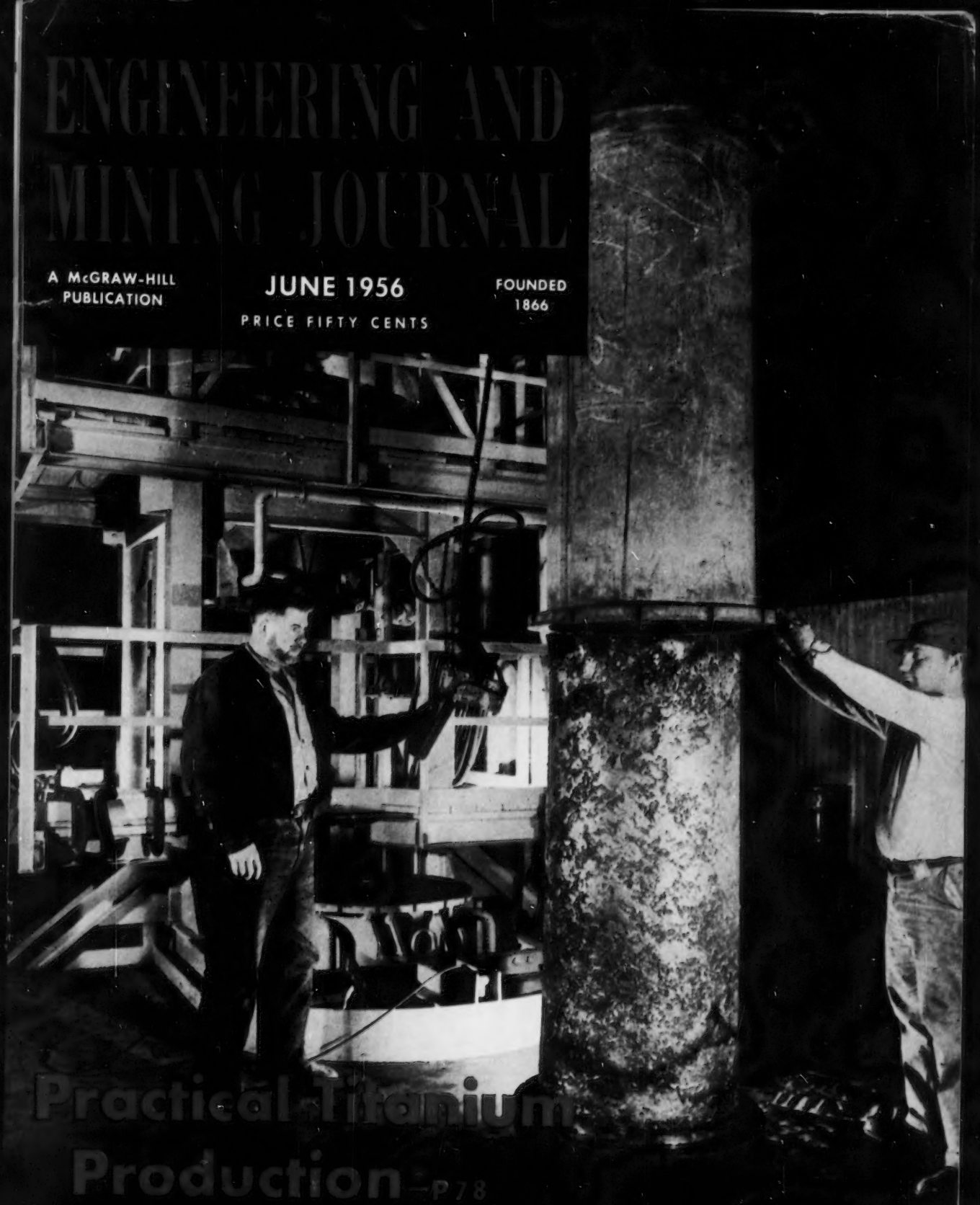

Practical Titanium Production—P78

plus—The Whup d' Whup and How it Speeds Tunnel Driving—P88

plus—What We're Learning About Tomorrow's Conveyor Belts—P90

One Centriseal pump leads to others in handling nasty corrosive slurries

One of the Centriseal Neoprene-lined, acid-fitted pumps installed at this plant.

F. S. Royster Guano Company, manufacturers of fertilizers and chemicals, have tough jobs for pumps at their super phosphate plant in Mulberry, Florida. Tired of frequently replacing worn-out pumps, they installed a Centriseal to pump slurries containing phosphate rock and hydrofluoric, phosphoric and sulphuric acids. The result – additional units of interchangeable Centriseal and Hydroseal Slurry pumps are now in operation.

INTERCHANGEABLE

***CENTRISEAL* Slurry Pump**
(No Sealing water)

HYDROSEAL Slurry Pump
(Sealing water)

Write us about *your* abrasive-corrosive pumping problem.

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Dept. B—259 E. Lancaster Ave., Wynnewood, Pa.
Representatives throughout the World

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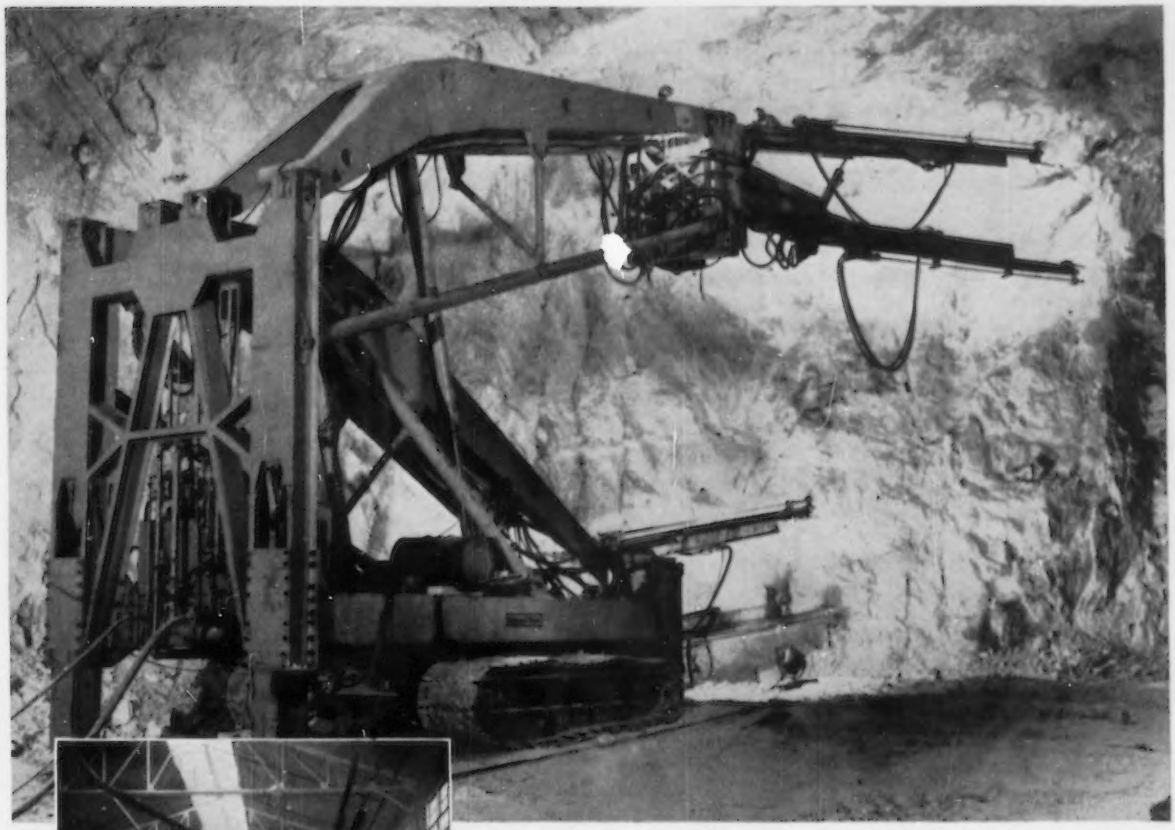
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



The huge, four-boom jumbo shown above is used for drilling a 60-ft. wide by 30-ft. high face in an underground limestone mine. Mounting four heavy-duty Drifters, it is powered by air motors and has separate hydraulic pumps and controls for each of the two cantelever booms. Drill guides for 19-ft. feeds have 8-ft. extensions and 30° side swing. Overall length, 52 ft. Height with cantelever booms lowered, 17 ft.

Shaft Jumbo

Tunnel Jumbo

Crawler Jumbo

Tractor Jumbo

Whether you need a

BIG JUMBO

or a small one...

you get maximum footage per shift

with HYDRA-BOOMS

Wherever jumbo mountings are called for – from the largest jobs to the smallest – Ingersoll-Rand Hydra-Booms save time, effort and expense by converting setup time into *drilling time*.

Hydraulic powered for raise, lower and swing, the fast-acting Hydra-Boom gives pin-point hole spotting at the touch of a *lever*.

Ingersoll-Rand has designed and built drill jumbos for practically every type of mining, quarrying and construction work. We will be glad to study *your* drilling problems and work out the type of mounting that will meet your requirements to best advantage. Write today for Bulletin No. 4162.

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ENGINEERING AND MINING JOURNAL

90th YEAR OF PUBLICATION

VOL. 157 NO. 6

JUNE 1956

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LETTERS

A Question of Variety

The article on p 120 of April 1956, "Pilot Plant Will Begin Uranium Lignite Research" is not clear and I would appreciate some enlightenment.

". . . if carbonaceous material could be burned off, but most lignite won't sustain combustion." Northern Pacific has been using lignites in locomotives for 40 yr and I don't see how they do it if the above is true.

"But even if the lignite beds run only 12-18 in. deep . . . the vast fields may lend themselves to open pit mining." At Forsythe, Mont., Northern Pacific has conducted a large open pit mine for years, and when opened, employed the largest shovels built, and the overburden was far in excess of 12-18 in.

Could you mean 12-18 in. *thick?* Not likely, as the immensity of these lignite beds is well known. As to thickness, 25 ft is not unusual. I am basing this inquiry on experience some years ago in the lignites of the Fort Union formation in Montana but the Dakotas are in the same province and I think conditions will be similar.

Leroy A. Palmer
Portland, Ore.

• Perhaps we did err in not making clear that the lignite in question was *uraniferous* lignite which will not sustain combustion as will the one mentioned by Mr. Palmer. The 12-18 in. figure should have read "thick." AEC says the uranium lignite beds may run from 6 ft to 3 in. in thickness but average 12-18 in. To quote an authority on the subject, "There are lignites and lignites."—Ed.

A Comment on Corruption

I have been intending to comment on "Labor This Month" in February *E&MJ*. I wonder how qualified the AFL-CIO officials are to eliminate corruption from the unions. The December 1954 *Reader's Digest* carried an article called "Joe Fay: He Ruled An Empire From Prison" which sheds a lot of light on corruption in very high places in the AFL. The article raises questions which have not received any satisfactory answer. The recent assault on Victor Riesel is a typical union answer to the charges.

As long as our labor law gives power without responsibility to labor bosses, irresponsible men will gravitate into high positions in labor organizations. Until Congress sees fit to correct the difficulty, articles like yours are just meaningless bandying of words.

How little chance there is of any attack of the problem at its roots is obvious from the current political campaign in which the leaders of the so-called Democratic party are busy licking the boots of the labor bosses.

Name withheld

B.F.Goodrich

TVA's Shawnee Steam Plant

How to burn 600 tons of coal in one hour

A typical example of B. F. Goodrich improvement in rubber

THIS is one of the nation's biggest power plants. Coal that goes into it could furnish electric power for a city the size of Detroit. There's a network of nearly three miles of B. F. Goodrich conveyor belts running in four different directions. One goes over towers 50 feet high, over a road and a river channel; others tunnel underground. They carry 14,000 tons a day into the plant.

One belt half a mile long, running from the river into the plant, would once have been a terrific problem. But B. F. Goodrich had made these big systems practical by developing the cord belt. Cords running lengthwise, buried in the rubber, add so much strength that a single belt can travel distances once considered impossible. It's flexible too, and stands crashing blows from heavy lumps or sharp edges that would gouge or break many ordinary belts.

All of the other belts have other B. F. Goodrich improvements too, brought by better manufacturing methods—such as making belts under uniform tension, so that all fibers work together; seamless plies to avoid weak spots; cushioned edges for longer wear; patented layers called "breakers" to stand hard blows; mildew treatment to protect fabric. All these improvements and many others help cut costs through better performance.

Call your B. F. Goodrich distributor for more information about any kind of belting—or hose or other B. F. Goodrich rubber products. *B. F. Goodrich Industrial Products Co., Dept. M-669, Akron 18, Ohio.*

B.F.Goodrich

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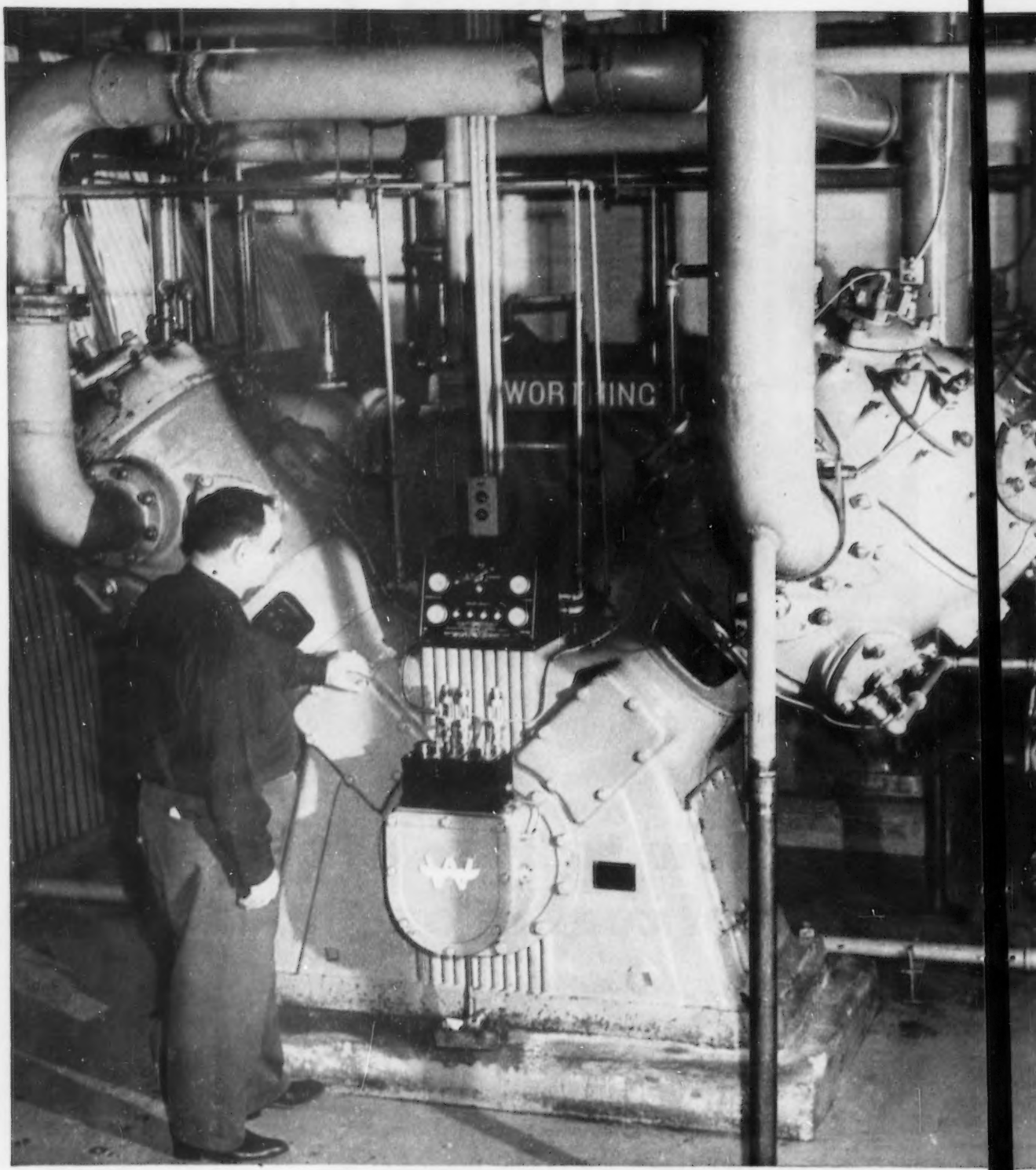

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on television . . .
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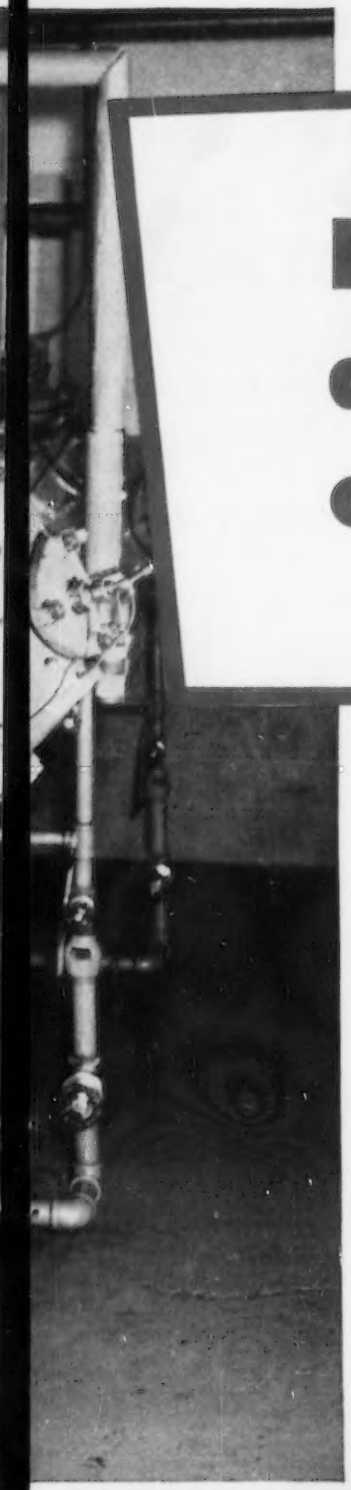

Keep rust and deposits out of your system

With *Texaco Regal Oil R&O* in your air compressor systems, you get highest operating efficiency, unhampered by rust or deposits. *Texaco Regal Oil R&O* is especially refined to keep compressors clean, to assure smooth-working valves and free piston rings. Naturally, you'll get more dependable performance at considerably lower maintenance costs.

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For your rock drills, use *Texaco Rock Drill Lubricant EP.* It protects against wear and prevents rust whether drills are running or idle—assures low upkeep costs.

Let a Texaco Lubrication Engineer help you select the proper lubricants. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

Lubricants and Fuels
FOR THE MINING INDUSTRY

Westinghouse-equipped ore unloaders break record by 436 ton-hours

Rugged Hevi-duty mill motors and SA brakes take tough shock treatment at 2350 tons an hour

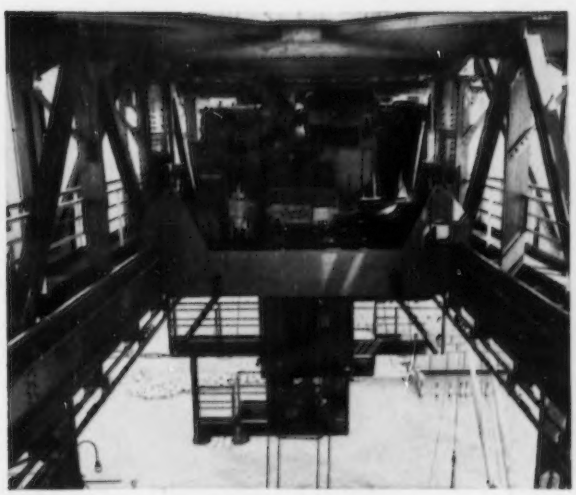
Westinghouse d-c motors with larger shaft diameters between rigid bearing supports are designed and built to break records in rugged operations like this.

This is just one reason why Westinghouse motors were specified by the Pennsylvania Railroad when a new ore unloader was needed to increase the production capacity. Another reason was the superior service record of Westinghouse motors on the unloaders already in use.

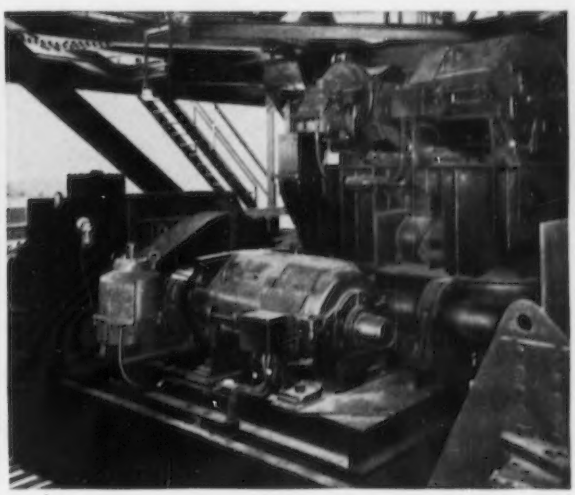
It will pay you to investigate the many other equally important factors about Westinghouse d-c motors and brakes that mean longer life and dependability. You can get all the details from your Westinghouse sales engineer. Call him today. J-21928

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***



Three million tons of ore in 1955 and production is still going up this year! The ability of Westinghouse motors and brakes to stand up under continuous loading and reversing duty makes them first choice for grueling operations like this.



Here is the heart of an ore unloader—Westinghouse Hevi-duty 600 Series mill motors and SA (self-adjusting) d-c brakes. Westinghouse engineers are ready to work with you to determine the characteristics you need for motors, controls and brakes.

Allis-Chalmers HD-21 Tractor; 204 net engine hp; 44,000 lb. • Allis-Chalmers 315 scraper; 15 cu yd struck, 20 cu yd heaped.

This Allis-Chalmers HD-21 is general handy man at the Furr Coal Company's mine. It builds and maintains incline ramps between cut and fill areas to provide short haul cycles. With rear-mounted ripper, it loosens overburden when necessary to insure continued, fast loading. It also acts as a stand-by pusher.

Two Allis-Chalmers HD-21 tractors and pull-type scrapers strip overburden, carry it down an incline and spread it in a worked-out section of the mine and return empty up another ramp. By this method, the Furr Coal Company reclaims land without rehandling material. Savings amount to 8¢ a ton or roughly $1.50 for every scraper load.

You can strip overburden and reclaim land *in One Operation*

with Allis-Chalmers crawler tractors and pull-type scrapers

Whether you are stripping iron, coal, clay or quarry stone, you are probably faced with the problem of reclaiming the worked-out land. This is where mobility of Allis-Chalmers tractors and pull-type scrapers is of real value. With this equipment, you can strip overburden from new deposits, then haul and spread it immediately in a worked-out section of the mine.

A typical example is The Furr Coal Company, Nelsonville, Ohio. On this operation, HD-21 tractors and Allis-Chalmers pull-type scrapers save an estimated cost of 8¢ a ton by eliminating a second handling of overburden. Overburden consists of earth and clay with very little rock. The big HD-21's have the power to load these 20-yd. scrapers—usually without a pusher—and the speed to complete the cycle quickly.

"I've owned other makes of tractors and scrapers," says Mr. Furr, "and I have these because I believe them to be the best." Mr. Furr likes the Allis-Chalmers diesel engine, the construction of the tractor and the fact that it has proven torque converter drive. He also estimates that its thousand-hour lubricating intervals save about 30 minutes' servicing time every shift . . . "and this really adds up to important savings."

Find out how Allis-Chalmers equipment can bring new efficiency to your stripping and reclamation work. See your Allis-Chalmers Construction Machinery dealer.

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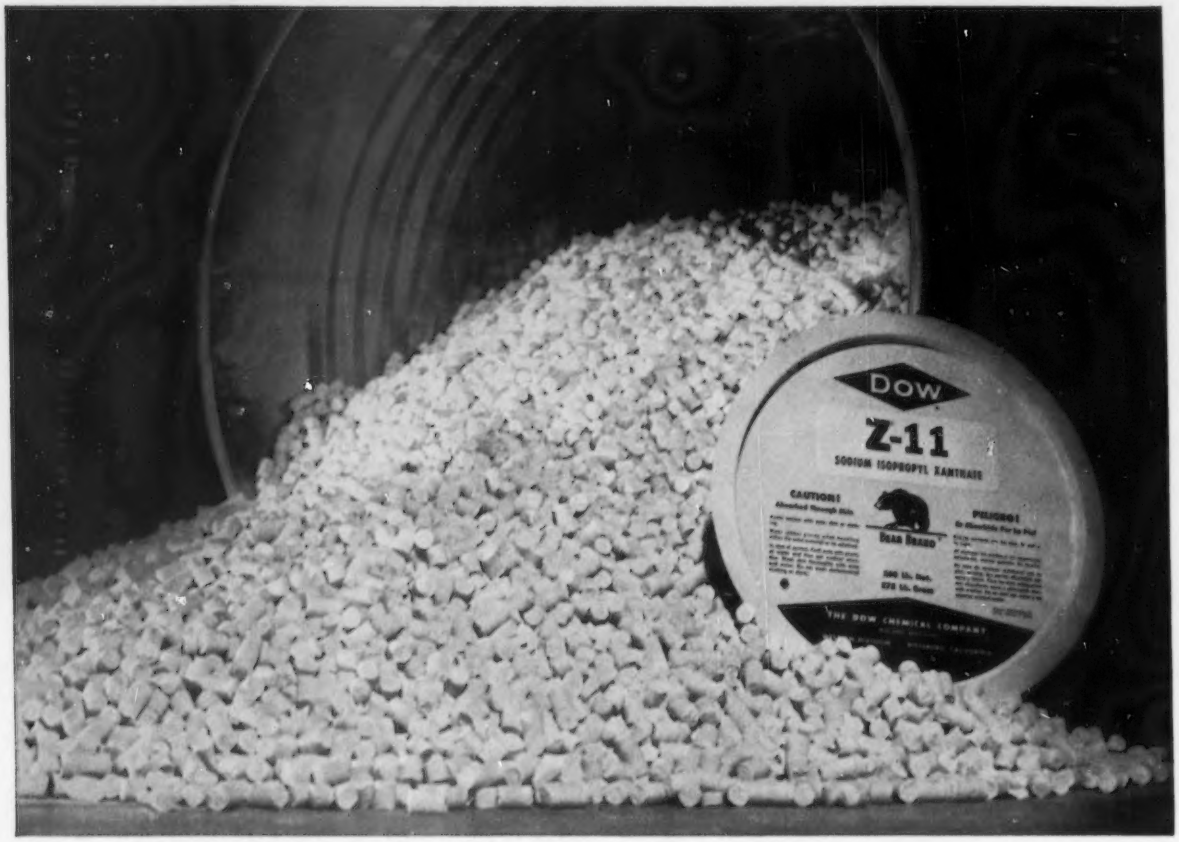

No waste . . . no spillage problems . . . no dust

when you use DOW Xanthates for fast, complete loading of collecting bubbles

Available as pellets that dissolve readily and completely in water, DOW Xanthates assure handling ease, as well as economy. Flotation mills the world over are increasing recovery and improving concentrate grade.

By using one DOW Xanthate or a combination, the metallurgist easily tailors his collector to suit the sulfide minerals to be floated. Bubbles collect faster, sustain maximum loads. And as ore conditions change, Xanthate feed can be adjusted quickly.

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Other DOW products that help cut recovery costs include Separan 2610®, a new flocculant that speeds settling and filtration operations; and Dowfroth® 250, a hard-working frother for both sulfide and nonsulfide minerals. For test samples and complete data write THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. OC857L.

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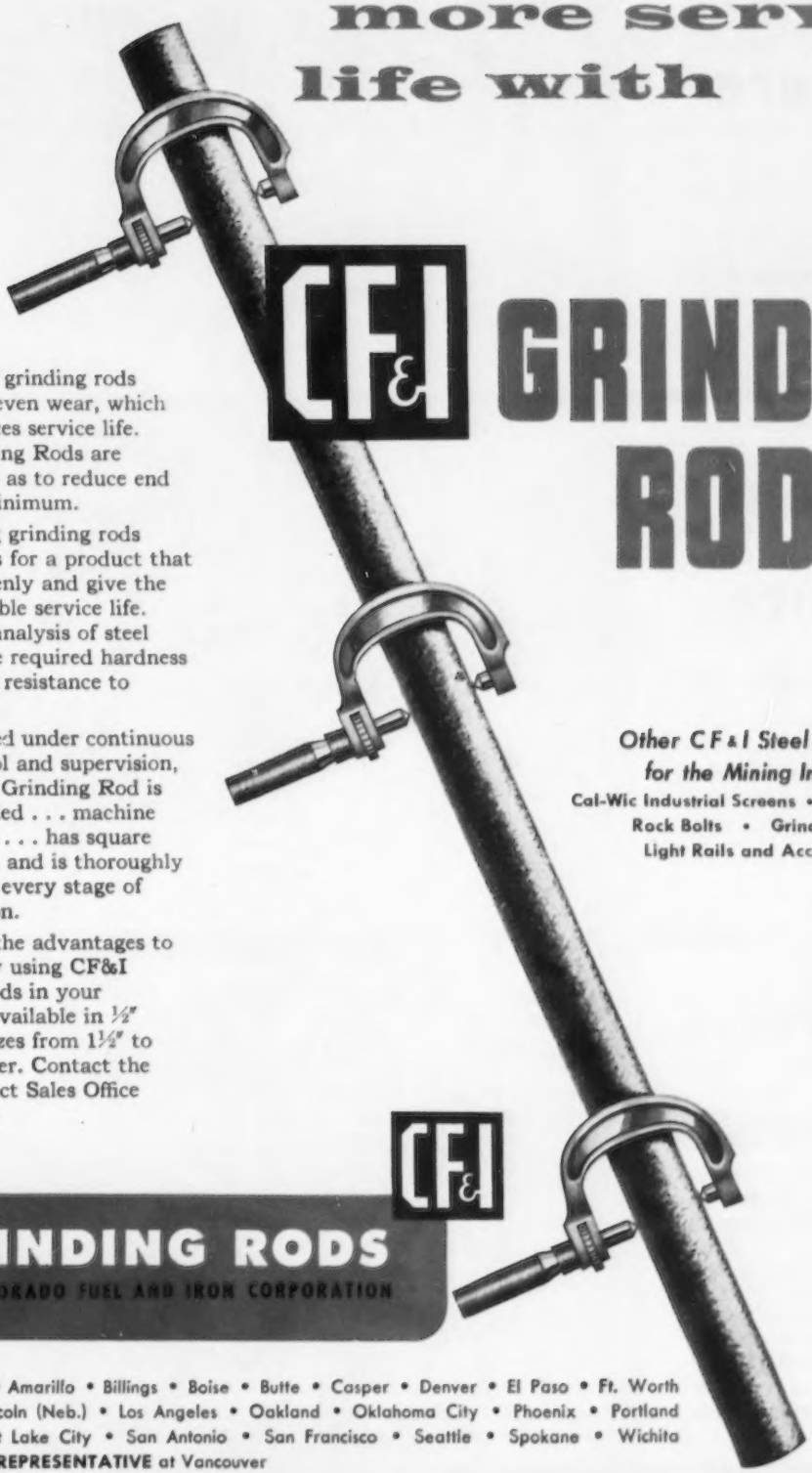

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End taper of grinding rods results in uneven wear, which in turn reduces service life. CF&I Grinding Rods are fabricated so as to reduce end taper to a minimum.

In producing grinding rods CF&I strives for a product that will wear evenly and give the longest possible service life. The proper analysis of steel results in the required hardness and superior resistance to bending.

Manufactured under continuous CF&I control and supervision, every CF&I Grinding Rod is carefully rolled . . . machine straightened . . . has square cut ends . . . and is thoroughly inspected at every stage of its production.

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A combination of powerful "pry-out" action using breakout pads as a fulcrum for leverage and a 40° bucket tip-back *at ground level* gets BIGGER LOADS with less spillage.

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Heaped loads are cradled closer to the machine for greater stability and can be carried at lower level. Exclusive load shock-absorber cushions the load during travel, smooths out the ride, and permits faster movement with less spillage.

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Since you get MORE to begin with and keep MORE while traveling at higher speeds . . . with less spillage in both instances . . . the result — you *deliver* MORE. This new PAYLOADER is a more PRODUCTIVE machine which will handle more yardage at lower cost.

more yardage at lower cost...
New 2¼ yard PAYLOADER®

The new model HO is the finest four-wheel-drive tractor-shovel ever offered. All the *exclusive* features that increase yardage output enable it to handle many kinds of jobs never before practical with wheeled tractor-shovels.

It operates easier and faster, rides smoother, with or without a load, than anything near its size. It has *balanced* design and durability throughout to turn out big production day after day. If you want *proof* of its *productive capacity* and superior *performance,* ask your "PAYLOADER" Distributor for a demonstration.

Safety and Stability

The safest and most stable wheeled tractor-shovel ever built. Moving members cannot injure operator because of underslung boom arm design and positioning. With loads carried lower and closer to the machine, cushioned during travel, and with longer wheel-base, the utmost in stability is achieved.

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Power-steering, power-brakes on all four wheels, power-shift with no clutching or stopping for range changes and good balance and riding qualities reduce operational fatigue — promote full production all day.

Digging Power

Pound for pound, the new model HO has more traction and digging power — for a wider range of ground conditions—than any wheeled tractor-shovel ever built.

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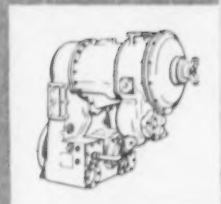
Torque-Proportioning Differentials *Reduce Wheel Slipping*

Another exclusive "PAYLOADER" feature which assures better traction under adverse conditions. If one wheel starts to spin, more power is delivered automatically to the other wheel.

Rugged planetary final drives in the wheel hubs, plus hypoid differential gearing keep torque low in axles, prolong life of drive-train parts as well as axles.



Complete Power-Shift Transmissions

"Complete" since ALL shifts can be made instantly and on-the-go, under full engine speed. There's NO STOPPING for a range-shift, there's no foot clutch pedal. With the forward-reverse control, the operator can "inch" the machine while maintaining full engine speed to provide maximum bucket lifting and dumping power. Torque converter drive cushions power-train shocks.

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726 Sunnyside Ave., Libertyville, Ill.
Send information on "PAYLOADER" tractor-shovels:

☐ model HO	☐ model HR	☐ model HU
2¼ cu. yd. heaped, 1¾ cu. yd. struck	1¾ cu. yd. heaped, 1½ cu. yd. struck	1 cu. yd. heaped, ¾ cu. yd. struck

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Wire Rope at Work—Running uphill and downdale, a long aerial tramway serves the properties of Northwest Magnesite Co., near Chewelah, Wash. Built by Riblet Tramway Co., this 13½-mile overhead conveyor hauls magnesite to the concentrating mill, and from the mill to the reduction plant. While loaded buckets travel one way, the empties run alongside in the opposite direction.

The system is built in two sections, or legs. Bethlehem traction rope, nearly 27 miles of it, hauls the buckets on both sections. Approximately 87,000 ft of this traction rope is 1-in. 6 x 19; the remainder is ¾-in. 6 x 7. The two lengths of rope have been in service since early 1953, and they are still going strong.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

MINING • QUARRYING • CONSTRUCTION • EXCAVATING • PETROLEUM • LOGGING • MANUFACTURING

Bill Martin, master mechanic, Utah Construction Co., Pima mine project, Arizona

"Union lubricants...keep 'em rolling day and night"

"We've had remarkably good success using Union Oil Company lubricants here at the Pima mine project. And in my opinion, Union's Guardol is the finest motor oil you can put into heavy diesel excavating equipment such as we are using to remove some 190 feet of overburden at Pima.

"As you can see we are working our *Cats, MRSs, Eucs* and other equipment to capacity. However, by adhering to rigid maintenance schedules and using top quality Union lubricants, we can keep 'em rolling day and night with an absolute minimum of downtime."

More and more of the world's largest equipment operators now specify Union's heavy-duty motor oils and multi-purpose greases. Why? *Because their experience has convinced them that Union Oil products are, in fact, the finest.* Ask your nearby Union Oil representative for his recommendations on lubricants for your equipment. Your experience with Union lubricants will convince you, too.

UNION OIL COMPANY 76
OF CALIFORNIA

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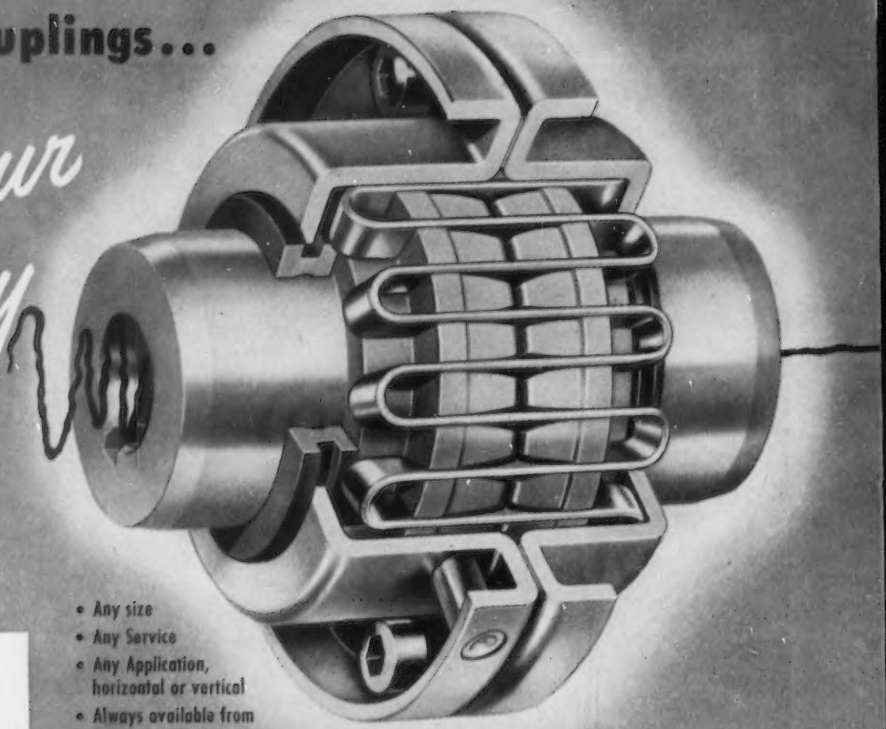
Falk Steelflex Couplings...

Protect your machinery in 2 ways



- Any size
- Any Service
- Any Application, horizontal or vertical
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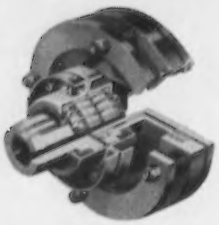
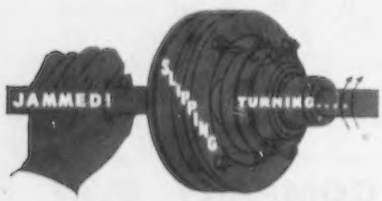


Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance . . . are easy to install, lubricate and disconnect . . . and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

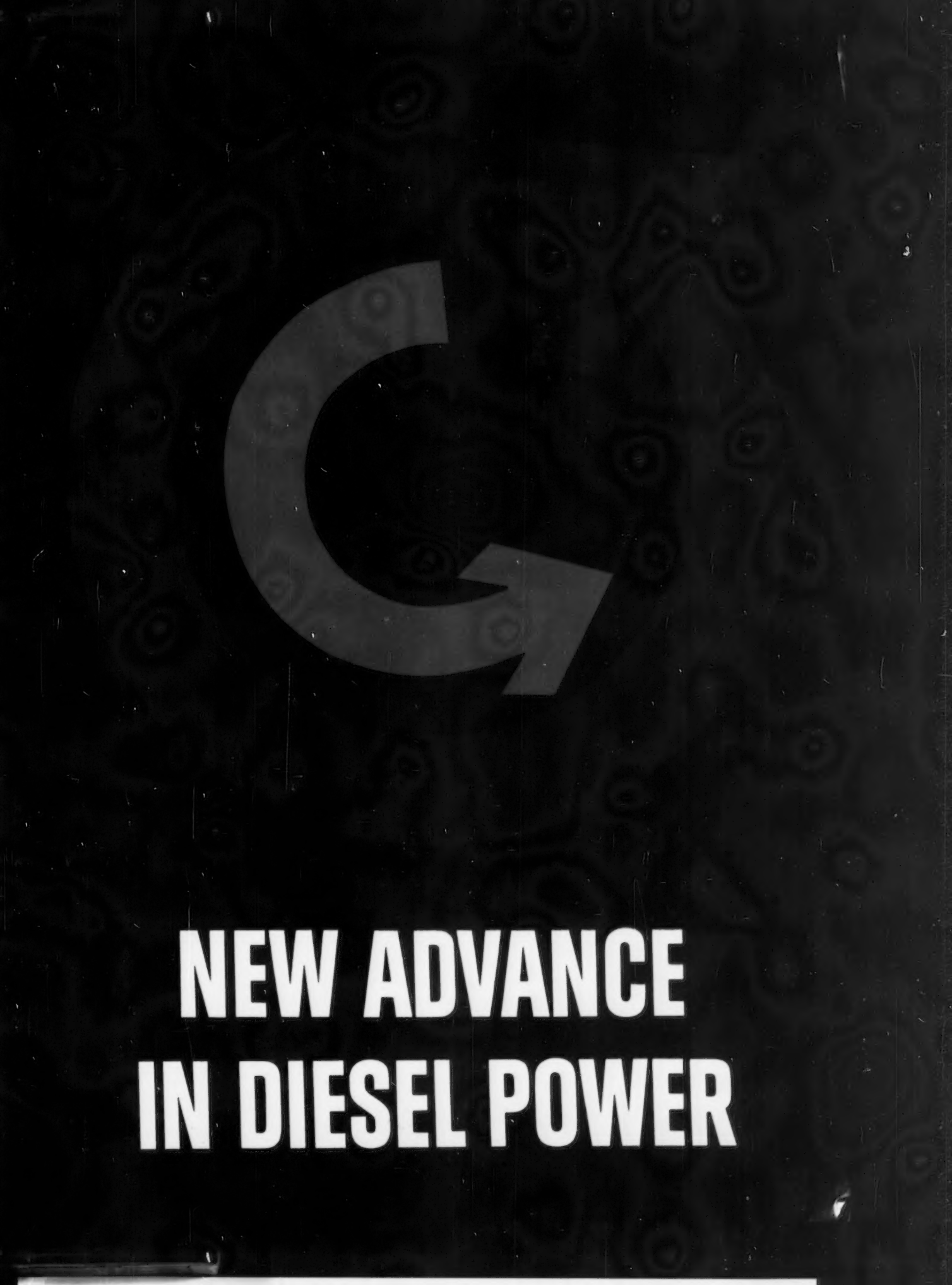
THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

MANUFACTURERS OF:

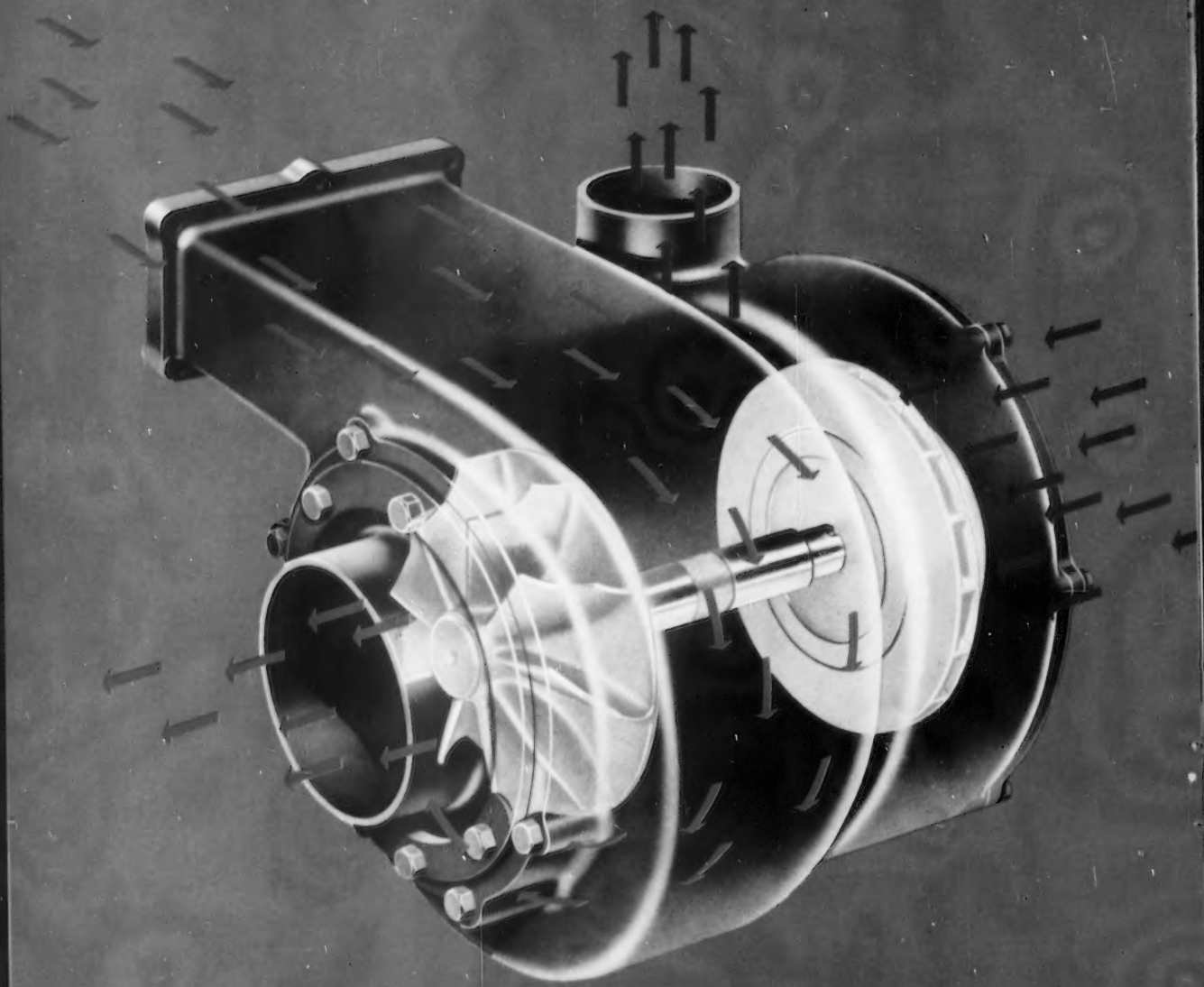
- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining


NEW ADVANCE
IN DIESEL POWER

CUMMINS **TURBODIESEL** ENGINE

(trademark)

ONLY CUMMINS OFFERS A COMPLETE LINE OF *TURBODIESELS!* . . .
THE LATEST AND MOST ADVANCED IMPROVEMENT IN DIESEL POWER!



Cummins *TURBODIESELS* convert ordinarily wasted power into *usable power!* This means more work from the same amount of fuel.

A *TURBODIESEL* is a Cummins engine that utilizes the normally wasted energy of exhaust gases by means of a turbocharger to develop additional horsepower. More power is obtained from a *TURBODIESEL* than from a naturally aspirated engine or engine of equal displacement, reducing the weight per horsepower. By forcing more air into the cylinders, the turbocharger makes possible more efficient burning of a greater fuel charge, creating additional horsepower.

The red arrows trace the flow of exhaust gases through a turbine chamber which turn a turbine wheel (left). The turbine wheel is mounted on the same shaft as the air impeller (right) in the air chamber.

➡ The blue arrows indicate how the rotation of this impeller draws air from the outside and blows it under pressure into the intake manifold and engine cylinders.

and what it offers to power users!

LOWER FUEL CONSUMPTION

Cummins *TURBODIESELS* deliver greater fuel economy than either non-supercharged or mechanically supercharged gasoline or diesel engines.

MORE HORSEPOWER, BETTER PERFORMANCE

Cummins *TURBODIESELS* deliver more horsepower than non-supercharged or mechanically supercharged diesel engines of equal displacement.

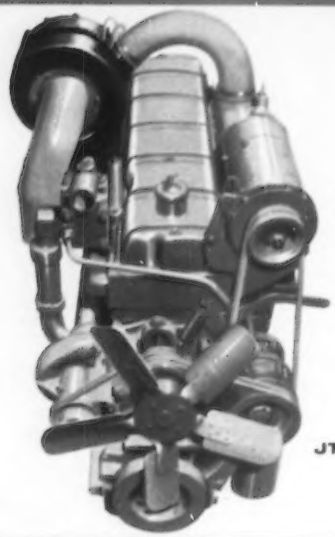
SMALLER SIZE, LOWER WEIGHT

Cummins *TURBODIESELS* are more compact, weigh less than non-supercharged or mechanically supercharged diesels of equivalent power.

How Cummins *TURBODIESELS* offer more profit to power users:

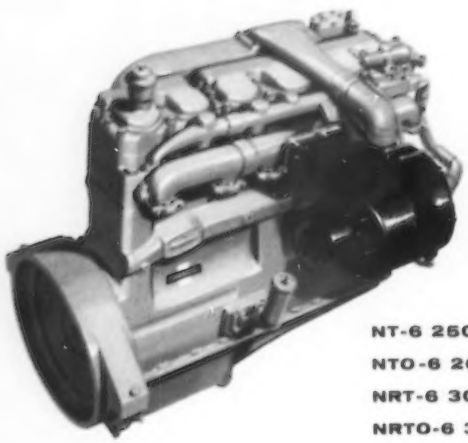
3 *big advantages!*	1 More work on the same amount of fuel!	2 More power for better performance!	3 More power per lb. of engine!
over non-supercharged diesels! ▶	If a non-supercharged diesel does this much work per gallon of fuel:	If a non-supercharged diesel delivers this much horsepower per cubic inch of displacement:	If a non-supercharged diesel delivers this much horsepower per pound:
and over supercharged diesels! ▶	a supercharged diesel will do this much work:	a supercharged diesel will deliver this much:	a supercharged diesel of equivalent weight will deliver this much power:
	but a Cummins *TURBODIESEL* will do more work per gallon of fuel than either!	but a Cummins *TURBODIESEL* will deliver more than either!	but a Cummins *TURBODIESEL* of equivalent weight will deliver more power than either!
If you run trucks or buses ▶	"Work" is *mileage*. Cummins *TURBODIESELS* mean more ton-miles per gallon than gasoline or other diesel engines.	Cummins *TURBODIESELS* make possible faster schedules . . . better performance on hills . . . at altitudes . . . in traffic, than gasoline or other diesel engines.	Cummins *TURBODIESELS* make possible bigger pay loads . . . dependable diesel power and economy . . . more profit.
If you use construction, mining, logging, drilling or marine equipment ▶	"Work" is production. Cummins *TURBODIESELS* work longer on the same amount of fuel than gasoline or other diesel engines.	Cummins *TURBODIESELS* make possible faster work cycles . . . greater work loads . . . better all-around performance.	Cummins *TURBODIESELS* increase payload capacities . . . simplify movement to location . . . allow greater cargoes.

Cummins offers a full range of power for all applications!



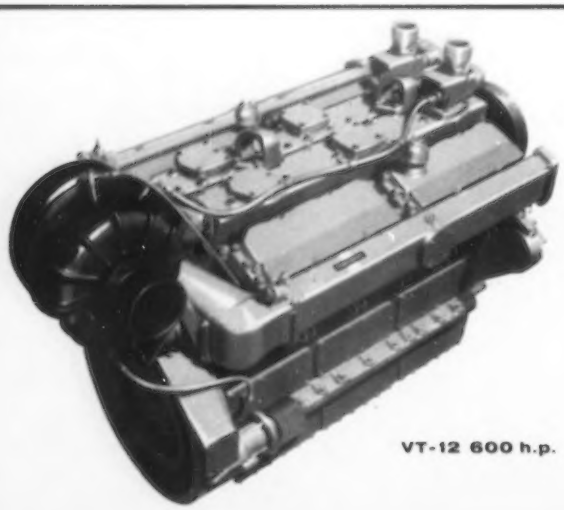
JT-6 175 h.p.

TRUCKS
BUSES
CONSTRUCTION
MARINE



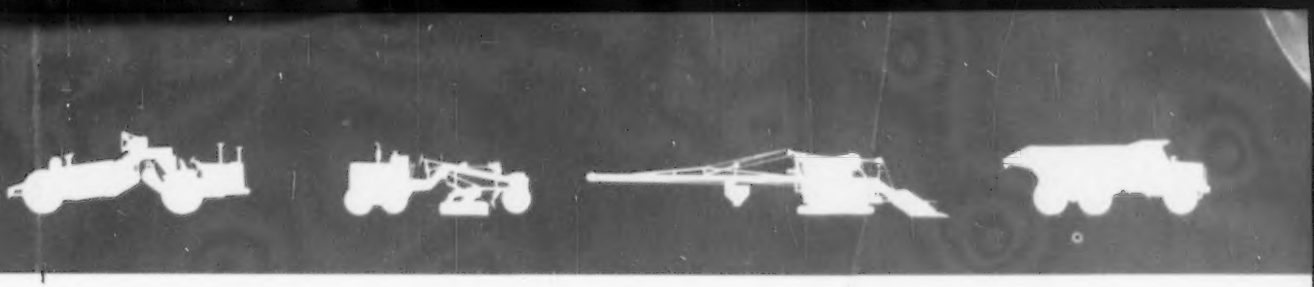
NT-6 250 h.p.
NTO-6 262 h.p.
NRT-6 300 h.p.
NRTO-6 335 h.p.

CONSTRUCTION
MINING
TRUCKS
LOGGING



VT-12 600 h.p.

MARINE
DRILLING RIGS
GENERATOR SETS
CONSTRUCTION



EFFICIENCY

Here is the engine that is revolutionizing the truck and bus industries. The JT weighs from 450 to 800 pounds less than other diesels of comparable power. This tremendous weight advantage means that diesel truck operators can earn from $1000 to $2000 in additional revenue every 100,000 miles. (Based on 300 trips of 300 miles each, and revenue of 80¢ per 100 lbs.)

More than 100 million miles of on-the-job performance have proved the JT's unmatched efficiency and economy as an automotive engine. The JT gives you maintenance costs lower than other diesels, *and as low as gasoline!* Compared to gasoline, the JT gives a 25% saving in maintenance hours!

The JT also is ideal power for medium construction, mining or marine equipment. This engine delivers the rugged, dependable performance that cuts work cycles—lowers operating costs.

POWER

Any piece of equipment powered by an internal combustion engine in this horsepower range will operate more efficiently, and economically, powered by one of these four great Cummins *TURBODIESELS.*

Cummins gives you a choice of horsepower so that you can accurately tailor power to your job needs. This avoids the excessive initial costs inherent in overpowering . . . the excessive fuel and maintenance costs inherent in underpowering.

These four great *TURBODIESELS* are thoroughly job-proved. They are particularly popular in construction and mining equipment, where their big power makes possible faster work cycles and more payloads.

DEPENDABILITY

Here is big power in a compact package. No other commercially available engine of comparable horsepower approaches the VT-12 Cummins *TURBODIESEL* for light weight and small size. The VT is easily moved from one location to another. And it costs much less than heavier, slow-speed diesels which develop comparable horsepower.

The VT-12 *TURBODIESEL* can cut the cost in any installation which must be moved from location to location, such as an oil well drilling rig. It makes possible higher powered portable generator sets and pumping units. In marine applications, it frees valuable space for cargo carrying. The VT-12 can be compounded to provide up to 2,400 h.p.

Cummins *TURBODIESELS* give you these advantages, too!

RESEARCH AND PRODUCT DEVELOPMENT. Continuous pioneering, research, experimentation and quality building has helped make Cummins the world's leading independent manufacturer of diesel engines. Meeting the ever-changing needs of power users by being first with the latest advances in diesel design and engineering keep "Cummins" the finest name in diesels. For more information, write for the free booklet, "Answers to Questions about Diesels."

READILY AVAILABLE PARTS AND SERVICES. Cummins worldwide distributor organization . . . the largest devoted to the sale and service of diesel engines . . . offers expert service and genuine Cummins parts at nearly 200 points throughout the United States and Canada and in over 100 export locations. Special job-site service is also offered.

LOWER FUEL AND MAINTENANCE COSTS. Cummins simple 4-cycle, overhead valve design is easy to service—assures long engine life—requires little "between-overhaul" maintenance—is easily understood by mechanics. Cost of replacement parts is low, minimizing overhaul expense. Cummins exclusive PT fuel system contains fewer parts—is easier to understand and maintain than gasoline carburetion and ignition or other diesel fuel systems. Foolproof and troublefree, this revolutionary method of fuel injection drastically reduces downtime due to fuel system failures.

MINIMUM PARTS INVENTORIES. Bearings, pistons and many other parts are interchangeable on many Cummins models. This standardization reduces overhead in parts stock—assures time and space savings—lowers maintenance costs. All components are made to exacting engineering standards under strict quality control to assure uniformity . . . lower your overall maintenance costs.

SPECIFY CUMMINS WHEN YOU BUY. It's easy to standardize on Cummins Diesels. Over 80 manufacturers of heavy equipment offer Cummins Diesels as power in over 500 models. The names of these manufacturers can be yours for the asking. Get your free copy of "Cummins Who's Who" by writing to the Cummins address listed below.

CUMMINS *MORE PROFIT*

gives you the big plus

For further information consult the Cummins Distributor in your area or write direct to:

Cummins Engine Company, Inc.
Columbus, Indiana

Bulletin 950135 LITHO U.S.A.

BIG 25-yard "B"

makes 180° turns in 35′

Steering motor, on king-pin housing, operates direct from current provided by Tournapull generator. With only two parts, rotor and stator, these brushless motors apply power simply. Motors are not affected by dust, moisture, rain, or sub-zero weather.

The BIG B Tournapull turns around without backing in a space only 35′ wide... over 5′ less than its 40′6″ over-all length. This 90° turnability lets you work in restricted areas and on narrow fills where other big scrapers cannot operate.

Maneuvers in close quarters

No steering jacks or other structural parts interfere with "B's" full 90° turns. Positive geared steer on king pin helps to maneuver fast in close quarters. These advantages mean bigger production in less time, and eliminate need for costly construction and maintenance of special turn-around areas needed for other rigs.

"Feather-touch" steering

Little effort is required to steer the B Tournapull. Electricity does all the work. Operator never has to "fight" steering wheel, no matter how tough the going.

An electric motor mounted on steering king pin turns a heavy-duty ring gear mounted on prime-mover. As ring gear turns, prime-mover pivots on the king pin. Prime-mover continues to turn as long as steering wheel is rotated. The instant this rotation is stopped, a brake automatically locks the steering motor. Tournapull then continues to travel in the selected direction, regardless of underfoot conditions, until wheel is again rotated and action repeated.

"B" walks out of soft spots

Positive electric power-steer makes it easy to work BIG "B" quickly out of a soft spot. Rotating wheel back and forth causes prime-mover to swing from side to side. This "walks" the drive wheels to fresh footing and moves trailing unit ahead with each swing of the prime-mover.

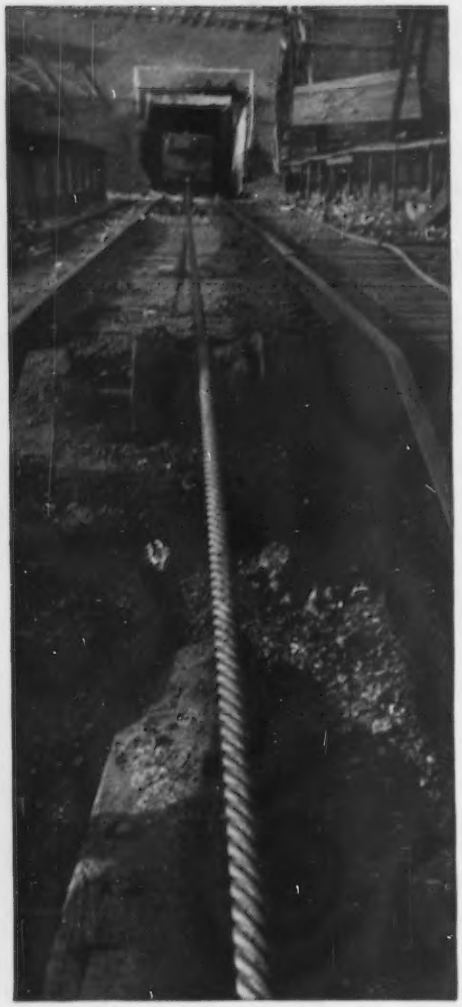
Why not find out for yourself how the BIG 25-yard B Tournapull, with its mudability and 180° turnability, can help you get bigger pay-yards on your earthmoving. Ask for owner-verified reports on "B" production.

Tournapull—Trademark Reg. U.S. Pat. Off. BP-964-G-b

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company



Macwhyte Internal Lubrication gives you rope prepared especially for your service conditions—designed to resist abrasion, internal friction, and corrosion on slope hoists.

Here's special rope ...made for mining!

Monarch Whyte Strand wire rope is available in the correct type and size you need for your equipment. This rope is made by Macwhyte to give you long, heavy-duty service on draglines, strip shovels, mine hoists, slope hoists, mining machines, loaders, and other mining equipment.

Monarch Whyte Strand is supplied properly PREformed for flexibility, and properly lubricated, depending upon the use of the rope, to resist abrasion, corrosion, and give maximum seryice.

Give Monarch Whyte Strand a chance to serve you. You will be more than pleased with its performance. Your Macwhyte distributor is stocked for immediate delivery.

Monarch Whyte Strand Bulletin 5425 is available from your distributor or write direct to Macwhyte Company.

MACWHYTE MINING ROPE

Macwhyte Company, 2937 Fourteenth Avenue, Kenosha, Wisconsin

Manufacturers of: Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel Wire Rope, and Wire Rope Assemblies. Special catalogs available.

New York 4, 35 Water St.
Pittsburgh 19, 704 Second Ave.
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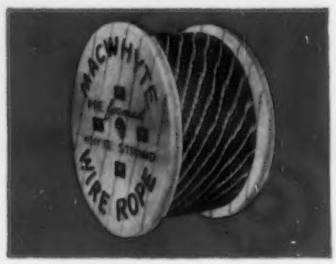
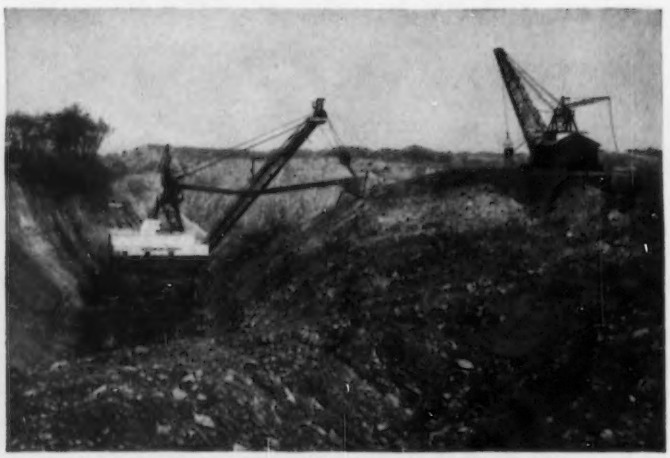
St. Paul 14, 2356 Hampden Ave.
Ft. Worth 1, P.O. Box 605
Portland 9, 1603 N. W. 14th Ave.
Seattle 4, 87 Holgate St.
San Francisco 7, 188 King St.
Los Angeles 21, 2035 Sacramento

Distributors conveniently located throughout United States



Macwhyte PREforming gives MONARCH WHYTE STRAND the flexibility for improved handling and long service. There's a type and size for all drag line equipment.



MONARCH WHYTE STRAND is made by Macwhyte in every wire rope classification to provide the correct size and construction for all strip mining machines.

One of the nation's major sources of titanium, this open-pit has produced 15,000,000 tons of ilmenite-magnetite ore and 8,700,000 tons of concentrates since its start in 1942. Over 17,000,000 tons of rocky overburden have also been removed. Entire deposit is 1800 ft. long, 900 ft. wide; averages 35% magnetite, 32% ilmenite, 10% feldspar and 23% iron silicates. All ore and waste must be shot...drill holes are sunk with a 42-T churn drill using a 9 inch bit, to 39 ft. deep. From 350 to 500 lbs. of 90% gelatin dynamite are used per hole...each lb. breaks up 3½ tons of waste and ore. A 4-yd. shovel, together with four 22-ton rear-dump trucks, loads all waste ...two 2½-yd. shovels, together with seven 15-ton trucks, move the ore. Finished ilmenite goes to processing plants, for conversion into titanium dioxide pigments for paints, paper, rubber, ceramics, and other substances. Magnetite concentrate is both converted to sinter and shipped raw to various iron, steel, refractory, and cement plants.

How rubber-tired tractors cut costs for one of world's largest titanium mines

In the heart of the Adirondack Mountains in upper New York State lies a mine which is one of the world's largest producers of titanium. From a pit 900 ft. x 1,800 ft. comes 3,200,000 tons of ore and waste yearly. Two rubber-tired Tournatractors shuttle back and forth to handle tractor work at pit, stockpiles, and plant.

1 tractor cleans around 3 shovels, 1 dropball, 11 trucks

One of these 17 mph 208 hp units is assigned mainly to pit and dump clean-up. At the pit, it cleans around *two* 2½-yd. shovels, *seven* ore-hauling trucks, *one* 4-yd. shovel, *and* a rubber-tired dropball crane. At the dump, a mile away, it cleans up for a fleet of 4 end-dump trucks. Rig shuttles continuously between assignments. A 300 ft. trip between shovels takes as little as 20 seconds ...the mile from pit to dump takes 3 to 5 minutes. Despite this busy schedule, tractor finds time to move air compressors, drills, and other pieces of pit equipment.

Another dozes magnetite weighing 4800 lb./yd.

The second Tournatractor is used primarily on the magnetite stockpile. Here it dozes concentrate within range of clamshell that loads railroad cars, or else dozes directly into a hopper. Rig's blade often carries 2½ cubic yards of material — weight *6 tons!* When needed, this tractor moves to other stockpiles to doze ilmenite concentrate or coal. Occasionally, it spots railroad cars in the sintering plant area. As needed, it cleans spillage from roads and haulage ways, and does other odd jobs. Wherever it goes, rig's low-pressure tires do no damage to footing. They roll easily over pavement, railroad tracks and ties.

Each costs $1 less per hour to operate than crawler-tractors

On shovel clean-up jobs, owners report Tournatractors outproduce the biggest crawler-tractors, 2-to-1. Units usually work at higher speeds and move job-to-job at higher speeds. Tournatractors cost less to maintain, too...4 tires eliminate the headaches of 500 to 600 track parts. Lowered maintenance, plus lower repair and operating costs are proved by accurate figures kept by the mining company. These show cost to operate Tournatractor "averages" approximately *$1.00 less per hour than their records of average cost for crawler-tractors.*

You judge its advantages

Tournatractor's lower costs, "go-anywhere" mobility, and fast-working speeds can pay off for you, too! Ask your LeTourneau-Westinghouse Distributor for a demonstration of this versatile machine so you can judge its advantages for yourself!

Tournatractor—Trademark Reg. U.S. Pat. Off. T-752-M-bw

▼ Dozing stockpiled magnetite, Tournatractor moves up to 2½ bank yards (about 6 tons) per push.

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

The Engineer's Field Report

CASE HISTORY

LUBRICANT *Calol Vistac Oil*

LOCATION *Utah*

Tough oil film protects mine roof bolters operating in water and heavy abrasive dust

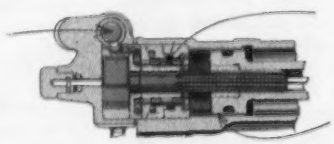
WORKING CONSTANTLY in heavy abrasive dust, high humidity and water, these Joy roof bolters (above) eliminate crossbar timbering, for safety and increased production in one of Utah's largest coal mines. Lubricated exclusively with Calol Vistac Oil 28X since first put in service, these air tools drill holes, hammer bolts and tighten nuts on steel bearing plates. Bolts up to 8 feet long are rammed in to refusal at pressures up to 3,000 lbs. psi. The master mechanic for underground operations at the mine reports: "Calol Vistac Oil has proved completely satisfactory for this tough service. It continues to lubricate and protect these machines even under our most difficult dust and water conditions." Calol Vistac Oil is also used in all other air equipment in the mine.

FREE CATALOG: "How to Save Money on Equipment Operation" will be sent on request to Standard Oil Company of California, 225 Bush Street, San Francisco.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your distributor, write or call any of the companies listed below.

CALOL

Why CALOL Vistac Oil cuts costs in air-tool equipment



Atomizes quickly and completely—carries evenly over all parts. Prevents excessive fogging and has no unpleasant odor.

Additives help form tenacious, oily, pressure-resistant film in wet or dry conditions—cuts wear and power loss. Small quantity lubricates efficiently.

Resists high temperatures and oxidation. Stays fluid at low temperatures.

TRADEMARK "CALOL", "VISTAC" REG. U. S. PAT. OFF.

STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas

Wide bowl-opening on Rear-Dump provides easy entry, big target for shovel, dragline, or conveyor loader. Units come in 11, 22, and 35-ton capacities.

Smooth, streamlined, unobstructed body dumping at 66° angle readily sheds sticky material.

Hauls to overburden dump are made at speeds up to 32 mph by this C Rear-Dump.

Big-tire haulers beat mud problem

A Canadian company had the problem of stripping 30 to 75-ft. layer of wet clay out of rock pockets. Soft and sticky with trapped-in moisture, this overburden was loaded by draglines, and hauled half a mile to waste dumps. Four C Tournapull Rear-Dumps were used to speed hauling.

Exceptional mud-ability

As owners everywhere have found, Tournapull Rear-Dumps go through mud which stops conventional truck-type haulers. On this overburden job, for example, these Rear-Dumps worked out of deep mud-holes in the pit and off dumps so soft a man could not walk through them. The exceptional mud-ability they showed is due partly to traction of big 21.00 x 25 low-pressure tires . . . partly to electric power-steer through geared kingpin which "walks" Tournapulls out of trouble . . . partly to exclusive differential which *automatically* transfers power from slipping wheel to wheel on firmer footing.

On rough haul-roads, Rear-Dumps with 5'6" diameter tires haul faster than trucks. The big tires grip and roll over the bumps, cushion machinery and operator from road shocks.

Turn around non-stop

These Rear-Dumps also work faster and with greater safety in narrow quarters than conventional haulers. They turn around in much less space. When bowl is raised, they shorten wheel-base to turn non-stop in an area about 1/3 less their overall length. This maneuverability speeds haul on narrow roads, reduces spotting time at shovel and dumps.

Dump fast and clean

Practically no clean-up is needed on the dump. With front-wheel drive, Rear-Dumps back safely to edge of bank. Bowl swings behind and below rear wheels . . . loads fall free and clear over the edge, with little spillage, seldom call for clean-up.

Ask your LeTourneau-Westinghouse Distributor to show you first-hand how Rear-Dump advantages can pay off on your work.

Rear-Dumps now available with optional tailgate.

Tournapull—Trademark Reg. U.S. Pat. Off. R-982-G-bw

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

EXTRA-TOUGH going calls for extra-tough AMSCO® DIPPERS...with Renewable Lip

On the Iron Range and in the Copper Mines, demands on dippers are really tough. And that's where Amsco Manganese Steel Dippers have proved they can "take it"... in years of rough use.

Amsco *Renewable Lip* Dippers are particular favorites here. For when the lip eventually wears out, this easily changed unit cuts "repair-time" to *one-tenth* that required for change-over of conventional designs.

The lip sides overlap and fit snugly into sockets in the back casting. Lugs on lip fit into slots in front casting and are secured by forged, split keys. Sturdy U-bolts fasten lip to back casting, pulling it tightly to dipper when double nuts are screwed down. The result is one-piece rigidity and strength, free of play in any direction.

You save two ways: first, through the extra-long service life of Amsco Manganese Steel Dippers; second, through quick and easy replacement of the Renewable Lip.

See your shovel manufacturer for full information on Amsco Dippers, or write us direct.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DELAWARE, OAKLAND, ST. LOUIS; JOLIETTE, QUEBEC

6 VACSEAL PUMPS

ready to take the acid test!

On the way to a challenging job, chosen over all competition . . . these 13 VACSEAL Pumps — and 27 more — will soon be in operation in the acid circuit of a large Canadian ore processing mill. VACSEAL was chosen basically for its unique "vacuum" design, its proven capacity for handling acids, slurries, and suspensions without gland water dilution. VACSEAL excels in the handling of valuable materials where slurry dilution and liquid losses must be avoided.

Materials being pumped by VACSEAL do not come in contact with the shaft or shaft sleeve when in operation. Wear of vital parts is thus reduced to a minimum. VACSEAL'S semi-open impellers give further assurance of long, trouble-free operation.

VACSEAL Pumps are manufactured in six sizes, capacities ranging from less than 20 to over 3,000 gpm. Pumps made acid-proof at low additional cost. Both rubber-lined types and alloy models are available. Any special information you require will be cheerfully supplied. Galigher has the answer to your "pump" problem.

Send for Bulletin PB55.

GALIGHER PRODUCTS
Commercial and Laboratory AGITAIR®
VACSEAL PUMP
Vertical VACSEAL Pump
Acid-Proof Sump Pump
Laboratory Ball Mills
Geary-Jennings Sampler
Geary Reagent Feeder
Laboratory Pressure Filters

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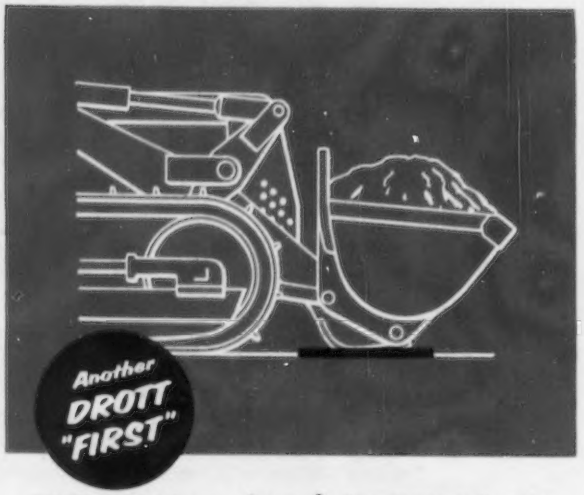
Agents in All Principal Foreign Mining Districts

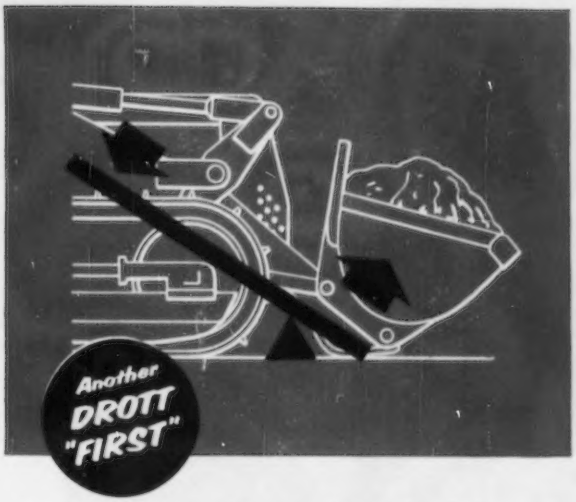
HOW YEARS-AHEAD INTERNATIONAL® DROTT® "FIRSTS" give you world-beating performance!

Major design features behind world-beating International Drott machine performance are not "flash" inspirations—not hastily-contrived imitations—not spur-of-the-moment attempts to "catch-up." Instead basic Drott features are "originals"—with years of patient and productive *field* and *engineering* experience in their conception and development. *By owning Drott equipment, you get the big profit-advantages of years-ahead design and performance—right now!* Look at the record! Compare the results!

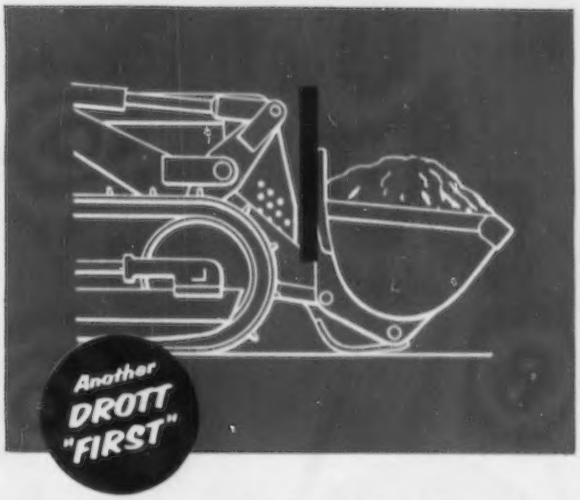
SINCE 1937... Closed hydraulic system Excludes abrasives and other foreign material—reduces wear and simplifies servicing. Keeps oil in; keeps air and dirt out.



SINCE 1944 . . . Load transport on patented, exclusive, frame-mounted skid-shoes Prevents tractor "teeter-totter"; saves carry strain by "semi-skidding" heaped loads. Increases yardage.

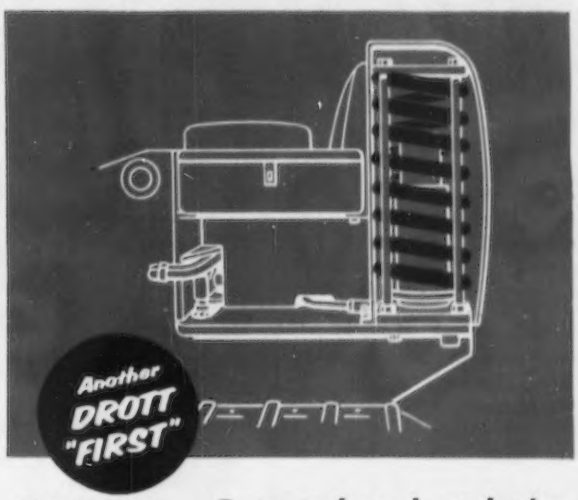


SINCE 1944 . . . Pry-action break-out Employs simple lever principle to give you *exclusive* triple-power digging force, ranging from 12,800 to 55,000 pounds! Shunts stresses into ground, so they can't maul bucket or tractor.



SINCE 1944 . . . Ground-level bucket roll-back Obtains heaped loads; *keeps the heap* to deliver extra yardage.

SINCE 1944 . . . Parallelogram raise action Keeps bucket at its 42° non-spill, roll-back level, all the way up. Increases yardage—avoids "spill-back."



SINCE 1946 . . . Patented and exclusive shock-swallowing hydro-spring Reduces effects of impact forces by 67%—to prolong equipment life, cut upkeep, reduce downtime, add operating comfort!

SINCE 1954 . . . Patented and exclusive DROTT Four-In-One Skid-Loader, bulldozer, Bullclam, clamshell, all in one—4-machine utility, one moderate investment. Now in 3 sizes, 1 yard to 2¼ yard capacity.

International Drott "firsts" like these combine to give you money-making performance and value *not available elsewhere*. You can prove it to your *satisfaction* and *profit*, by demonstration. See your nearby International Drott Distributor!

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 8, Wis.

INTERNATIONAL HARVESTER

INTERNATIONAL®
DROTT®

Operating plants are today proving the worth of Catalytic's ability to design for profit.

Pioneering achievements in such diversified fields as metallurgy, petroleum, chemicals, and petrochemicals are recorded in concrete and steel.

The skill, creative ability, and experience of Catalytic's personnel, alone or supplementing the engineering forces of your own organization, can create the kind of plant that will produce profits for you.

CATALYTIC

CONSTRUCTION COMPANY

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In Canada:
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CATALYTIC *ON-TIME*... *ON-BUDGET* SERVICES
for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction; Plant Operation

High Speed Reduction to Micron Sizes — No Attritional Heat!

ENGINEERING FLUID-JET GRINDING IN "PACKAGE UNITS"

. . . comes naturally to Sturtevant engineers — with their 75-year tradition of successful solving of dry-processing problems. If you want to accomplish the most effective grouping of a Micronizer* Grinding Machine with necessary compressor, feeder and dust-collector, it will pay you to investigate. Check the coupon on the right for more information.

Sturtevant Micronizer* Grinding Machines Give Greater Finenesses than Tube or Roller Mills

Look at the record! 30 inch model reduced titanium dioxide to 1 micron and finer at solid feed rate of 2250 lbs. per hr. 24 inch model reduced DDT (50%) to 3.5 average microns — 1200-1400 lbs. per hr. 8 inch model reduced Procaine—Penicillin—to 5 to 20 microns—up to 20 lbs. per hr. Couldn't you use milling performances like these?

No moving parts. The particles grind each other. High-speed rotation and violent grinding impact of particles are caused by jets of compressed air or steam at angles to the periphery of the shallow grinding chamber. There are no problems of attritional heat. Centrifugal force keeps over-sized particles in the grinding zone. Cyclone action in the central section classifies and collects the fines for bagging.

Instant accessibility, easy cleaning. Micronizer* Grinding Machines come in seven sizes — each one constructed for quick accessibility and easy maintenance (typified by the "OPEN DOOR" design in other Sturtevant equipment). Grinding chambers range from the 2 in. laboratory size with ½ lb. per hr. capacity to the 30 in. size which handles up to 3000 lbs. per hr.

* Registered trademark of Sturtevant Mill Co.

STURTEVANT

Dry Processing Equipment

The "OPEN DOOR" to *lower* operating costs over *more* years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

My dry-process materials are: _____

Desired capacity is: _____

Name _____ Title _____

Firm _____

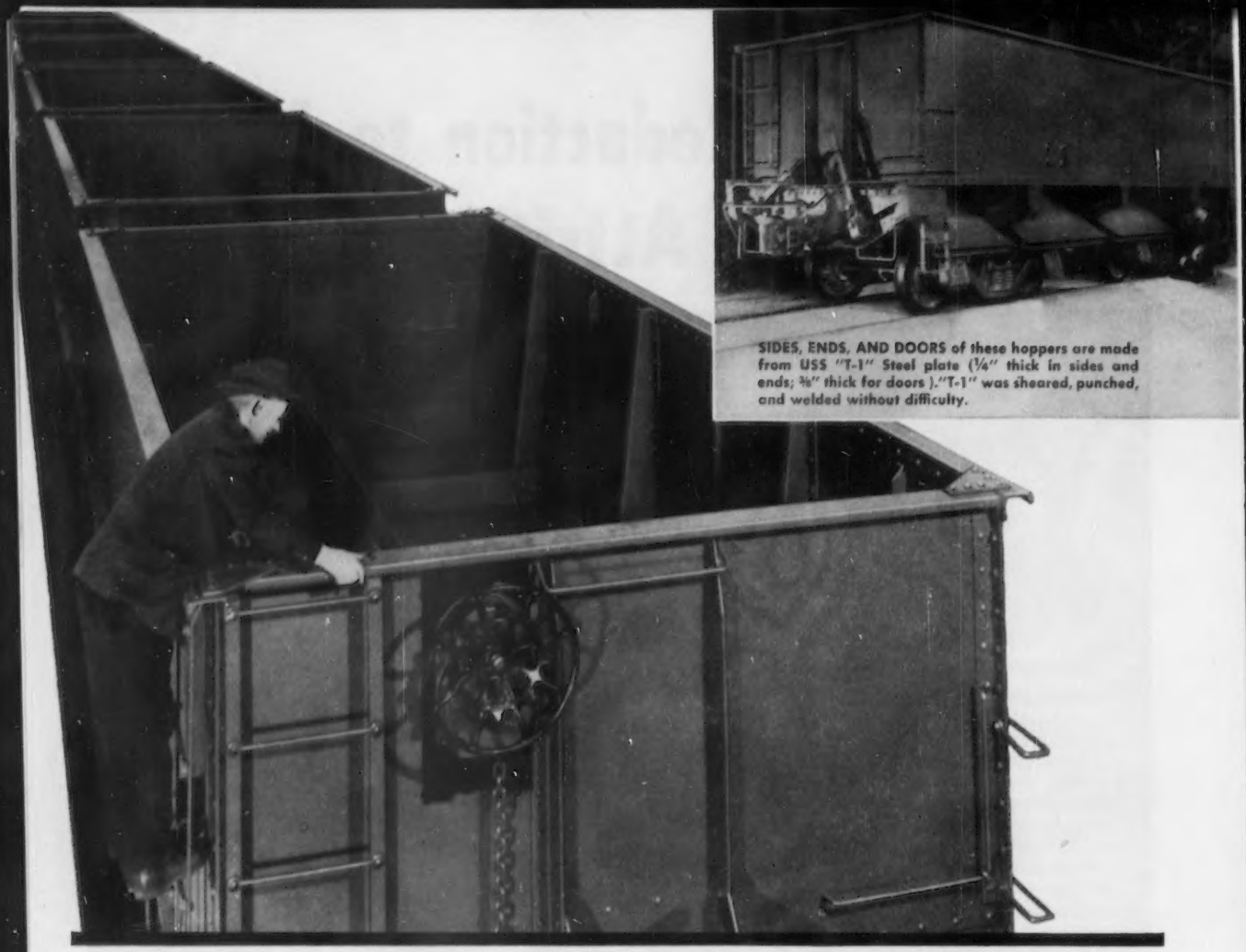
Street _____

City _____ Zone _____ State _____

STURTEVANT MILL COMPANY 101 Clayton Street, Boston 22, Mass.

Please send me your Micronizer* Bulletin ☐
Also bulletins on machines for:

☐ CRUSHING ☐ GRINDING ☐ PULVERIZING
☐ SEPARATING ☐ BLENDING ☐ MIXING
☐ SUPERFINE SELECTING ☐ GRANULATING ☐ CONVEYING



SIDES, ENDS, AND DOORS of these hoppers are made from USS "T-1" Steel plate (¼" thick in sides and ends; ⅜" thick for doors). "T-1" was sheared, punched, and welded without difficulty.

60 ORE CARS FOR INTERNATIONAL NICKEL CO. BUILT WITH USS "T-1" STEEL

Unique 3-way superiority of "T-1" Steel dictated choice

Copper and nickel ores are extremely hard and abrasive. Nevertheless, ore cars must last a long time. They must withstand severe corrosion, tremendous impact and abuse, day after day, for years. In the cold belt of northern Ontario, they must stay tough and durable, be able to take tremendous abuse, even at sub-zero temperatures.

The one steel that fills *all* these requirements, at the lowest cost for top performance, is USS "T-1" Steel. So International Nickel Company of Canada specified USS "T-1" for 60 new ore cars, built by Canadian Car and Foundry Company, Limited, for use in the largest nickel mining operations in the world, in the Sudbury District, Ontario.

In these cars, USS "T-1" Steel, which has a yield strength of 90,000 psi, plus amazing ability to withstand impact at low temperatures, is expected to increase service life substantially over cars made of carbon steel. Its far greater strength and toughness and ability to withstand abrasion should materially reduce maintenance and the need for part replacement. Result: more continuous operation and lower costs.

WHERE CAN YOU USE USS "T-1"?

Look around *your* operation. If you are in the mining business, or if you're in the business of building equipment for mines, USS "T-1" has a place. In many mines today, USS "T-1" is lengthening service life, reducing weight and cost, simplifying fabrication, increasing capacity of rugged mining equipment. It can do the same for you. Write for details. Or wire, or phone. United States Steel, Room 5335, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

UNITED STATES STEEL

Gardner-Denver . . . Serving the World's Basic Industries

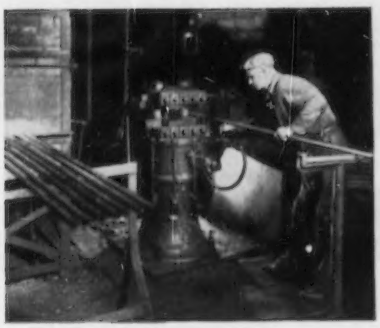
Lightweight Air Feed Leg Drills

Automatic Water-Control Stopers

Load-Lugging Airslushers

Fast-Drilling Drifters

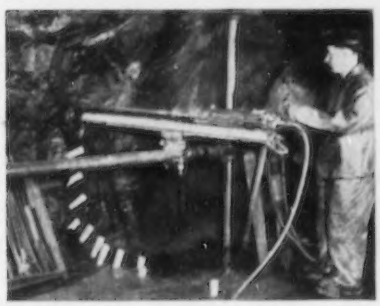
Quality Gardner-Denver cost-cutters for development and production



Drill Steel Shapers and Sharpeners

Push-Button Mobiljumbo

De-Watering, Grout and Sump Pumps



Deep Hole Drilling Equipment

Air Compressors, All Types and Sizes

Fast, Safe Mine Car Loaders

See your Gardner-Denver mining equipment specialist — or write for bulletins.

GARDNER - DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois
Export Division 233 Broadway, New York 7, New York
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

Transportation. The 4-Wheel-Drive 'Jeep' Truck transports tools, equipment and men around the mine or between mines—wherever you need to go. It travels the highway in conventional 2-wheel drive. Then for rough going—through mud, sand, soft earth, over rocky terrain or up 65% grades—it shifts easily into 4-wheel drive for all-wheel traction to take you "anywhere-anytime".

'Jeep' vehicles GO where others can't to speed mining operations!

Mobile Power. With power take-off, the Universal 'Jeep' supplies mobile power to operate many types of special equipment from this mobile drill to winches or compressors.

Prospecting. The Universal 'Jeep' is a workhorse in all types of prospecting operations. With the extra traction of its 4-wheel drive, it takes men and equipment cross-country, over the roughest terrain, in good weather or bad.

'Jeep' vehicles get through when ordinary vehicles bog down in the heavy rough going of mining projects. Their rugged "go-anywhere" ability makes them ideal for use in every phase of the mining industry—from exploring or prospecting in remote areas to keeping maintenance work and service around the mine moving on schedule.

'Jeep' vehicles are the only 4-wheel drive vehicles in their weight class time-tested and performance-proved in billions of miles of transport service. They're the only vehicles originally designed and engineered completely for 4-wheel drive off-the-road use. They work for you 365 days a year. The extra traction of their 4-wheel drive takes them up steep inclines or over rocky ledges—anywhere you need to go! And they tow heavily-loaded ore trailers on or off the road—in good weather or bad.

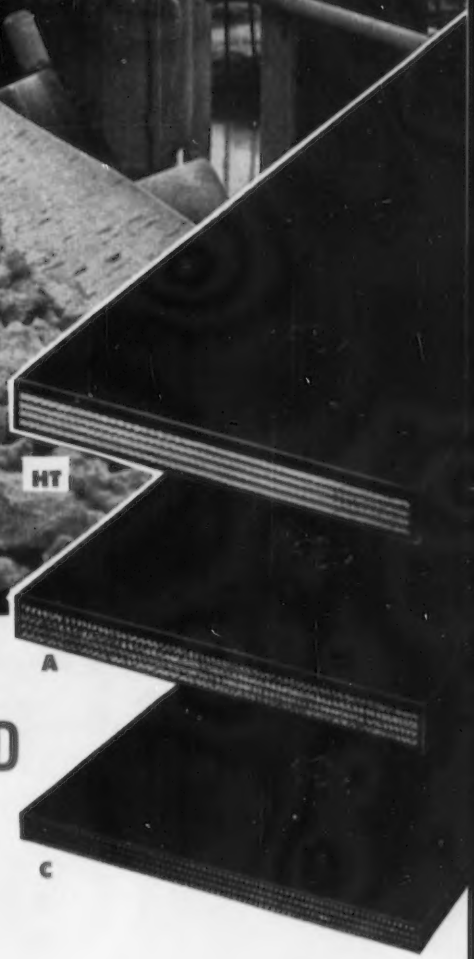
Versatile 'Jeep' vehicles spread their costs over a wide variety of jobs... provide additional savings through long life, low upkeep and high resale value. Ask your Willys dealer for an on-the-job demonstration, or write for information.

The 'Jeep'®

family of 4-Wheel-Drive vehicles

WILLYS... makers of time-tested utility vehicles

WILLYS MOTORS, INC., TOLEDO 1, OHIO



delivered...by THERMOID

This Thermoid conveyor belt is handling bauxite at an unloading dock in Baton Rouge, La. It was selected for maximum flexibility and resistance to loading impact.

Whatever your materials handling job, there are Thermoid conveyor belts designed to meet your requirements. For example: Thermoid HT for extremely abrasive materials such as quartz ores, trap rock and coal . . . Thermoid A for highly abrasive materials: slag, lime rock, ore, ashes, hot cement and crushed stone . . . Thermoid C for moderate abrasives such as sand, loam and gravel.

Put belts like these to work on your conveyors. Get the long wearing advantages of Thermoid's exclusive impregnation process. It welds belt carcass and cover into a real brute for punishment! Thermoid's specially woven, finest quality reinforcement troughs easily—withstands shock loading like no ordinary belt can do.

Your Thermoid Distributor will be glad to help you select the conveyor belt that's right for your needs.

Thermoid makes many types of hose designed for specific mining applications. Quality construction saves hose dollars.

Maximum efficiency in power transmission is assured with long wearing matched sets of Thermoid Multi-V Belts.

Thermoid

THERMOID COMPANY, Trenton, N.J.

how to get the most out of HOLLOW DRILL RODS

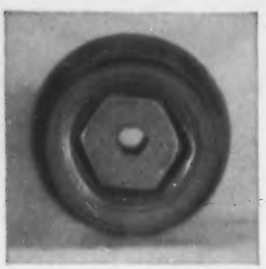
Modern drill rods – especially new *alloy* hollow drill rods like Crucible CA DOUBLE DIAMOND or 4E – give longer drill life than was possible with straight carbon rods. They'll give you lower cost per foot of hole drilled on the job. They will, that is, if you let them. For *abuse* will stop even the best steel from doing its best job. And you pay the price in higher drilling costs.

Rods properly racked and stored give better service.

Take, for example, MAINTENANCE:

DRILLS — Pneumatic drills are often so badly in need of repair that good drilling is impossible. Early failure of any rod used in these drills is inevitable. The solution is regular, periodic inspection of all drills and equipment – replacement of worn or damaged parts.

The damaged and worn striking faces of these pistons prevent impact from being transmitted to the rod in a straight line. Rod failure results.



BITS — Keep bits sharp. A dull bit binds in the hole, and drills so slowly that little useful work is performed. But the drill steel must absorb the rugged blows of the hammer.

Proper bit maintenance pays off.

RODS — It's a temptation to store drills by throwing them into one big pile. Resist it. For nicks and surface damage result – drill failures occur at points of damage.

It pays big dividends to make good maintenance a habit. Quality drill steels, like Crucible CA DOUBLE DIAMOND or 4E Alloy Hollow Drill Rods, are made to give long service, lowest cost per foot of hole drilled. They're tough, strong, made to tool steel standards. This *extra* quality assures you of minimum rod breakage, fewer valuable bit losses. But to bring out the best in 'em, you've got to do your part by keeping equipment in shape.

Crucible hollow drill rods are always quickly available in the sizes and types you need. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

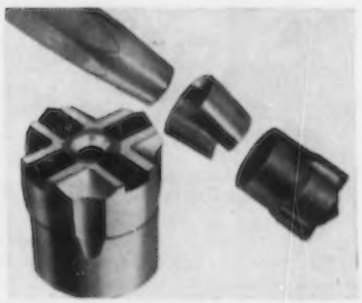
LLOYD E. ANTONIDES, Assistant Editor

Dump Truck (1)

Electric traction motor drives this end-dump truck made by Kenworth Motor Truck Co., Seattle, Wash., for underground hauling. One of four units delivered to Riverside Cement Co.'s limestone mine at Crestmore, Calif., it is believed first of kind in U. S. During mile-long haul, power comes from a pair of overhead wires and trolleys. Cable reel under front hood permits operating away from wires during loading. GE cooperated on design and furnished electrical equipment including main 550v drive motor, located where transmission usually is, and another of same size, under hood, for powering auxiliary equipment. Struck capacity of Model 802-E is 16 cu yd or 24 tons. Top speed empty is 25 mph on level. Loaded, it is 10 mph up 10% grade. Compressed air is used to maintain length of trolley poles.

Separator (2)

Amalgamating low grade ore of gold and other precious metals, especially if colloidal, is aided with this electric unit, says Complex Minerals, Phoenix, Ariz. Mercury in grooves in trough and two sets of electrodes above are used to pass low voltage dc through flowing pulp while fluctuating high voltage dc or ac field is applied across it.



TC Rock Drill Bit (3)

Used to destruction and thrown-away, Tee-Cee combines features of Liddicoat one-pass steel bit and superior footage of sintered carbide, says Thompson Products Ltd., St. Catherines, Ont. Connection is simple 11-deg conical taper. Brass shim is said to obviate close tolerances and make removal easy. Field tests reputedly show substantial cost cuts.

Grinding Media (4)

Diamonite grinding rods are square cylinders about 1 in. in size, composed of synthetic sapphire in vitreous bond. Faster grinding action, practically no contamination and long life are said to mean more capacity and lower costs for ball mills. They offer the highest wear resistance of any material for grinding, says U. S. Ceramic Tile Co., Canton, Ohio.

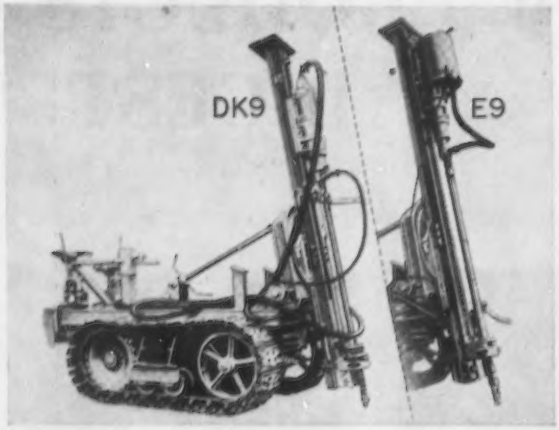
Earthmoving Equipment (5)

A 24-ton, as well as an 18-ton model, rear dump truck, and a 1¾-cu yd, rear-engine crawler-mounted front-end tractor-loader were shown at a recent exhibit and demonstration of the latest earthmoving equipment now available from International Harvester Co., Chicago, Ill., and its subsidiary the Frank G. Hough Co. Also announced was a line of V-8 gasoline truck engines of 206, 226 and 257 hp designed for heavy duty performance.

The Models 95 and 75 Payhaulers and the Model 12 Payloader are additions to the re-engineered Payscrapers and crawler tractors announced in last month's NPD. International claims they have a broader line than any other construction equipment manufacturer in the industry.

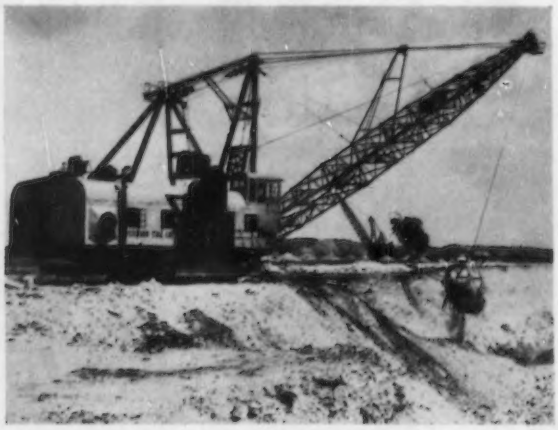
Fastening Tool (6)

Like driving pin through penny with cake of soap and hammer, Shure-Set by Olin Mathieson Chemical Corp., Cleveland, Ohio, can drive the special fasteners through ¼-in. steel. Designed for lighter work than their powder-actuated Ramset system, this manually-powered unit can quickly fasten almost anything to anything, it is claimed.



Rotary Rock Drills **(10)**

Compressed air (left, DK9) or electric (right, E9) rotary machines are mounted on a variety of driven or towed carriages by Hausherr. For holes about 2 to 4 in. in soft to medium hard ground, units are offered through B. J. Nykerk Corp., New York. Both use 9-hp motor for drilling and 4-hp one for feed.



Walking Draglines **(11)**

Becket system on line of 5- to 15-cu yd single deck walking draglines now offered by Page Engineering Co., Chicago, Ill., strengthens boom for reputedly faster and easier operation. Added to this is a V-type horizontal diesel which gives what it claimed a new concept in design, power and economy.

Safety Light **(12)►**

Designed for better visibility and dependability, Edison four-cell Trip Lamp by Mine Safety Appliances Co., Pittsburgh, Pa., is claimed quick to hang on car and needs no special charger.

Truck Tire **(14)**

Terra-Tire, a barrel-shaped low-pressure pneumatic tire by Goodyear Tire & Rubber Co., Akron, Ohio, has axle which now permits use of conventional drive and moves it closer to industrial use.

Drafting Vellum **(15)**

Erasability of Blutex tracing vellum is highly improved by using all synthetic resins, says Frederick Post Co., Chicago, Ill. Dry, but not brittle, surface will not fuse with graphite, it is said.

◄Clamshell Bucket **(13)**

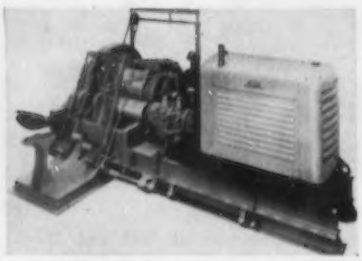
To speed shaft mucking, Blaw-Knox Co., Pittsburgh, Pa., has introduced a clamshell bucket with integral single drum air hoist for closing. Sizes are ⅜ and ⅝ cu yd.

Safety Mask **(16)**

Thirty-five-pound weight and one-third more working time are only two of many features claimed for self-contained oxygen Air Mask developed by Fyr-Fyter Co., Dayton, Ohio.

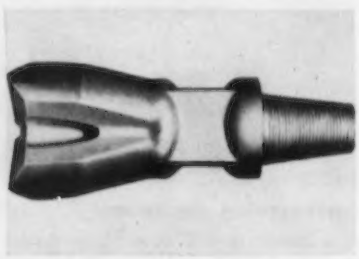
Surveying Level **(17)**

Easy and fast set-ups and operation are reported for N-3 precision level by Wild Heerbrugg Instruments Co., Port Washington, N. Y. Bubble is observed through magnifying telescope. Accuracy stated is ±0.01 in. in mile of single levels.



Mine Hoists **(18)**

Smaller mines are promised a combination of ruggedness, operating convenience and maintenance economy with Vulcan-Denver, 45 to 110 hp, series of hoists by Vulcan Iron Works Co., Denver, Colo. Fluid coupling is one feature.

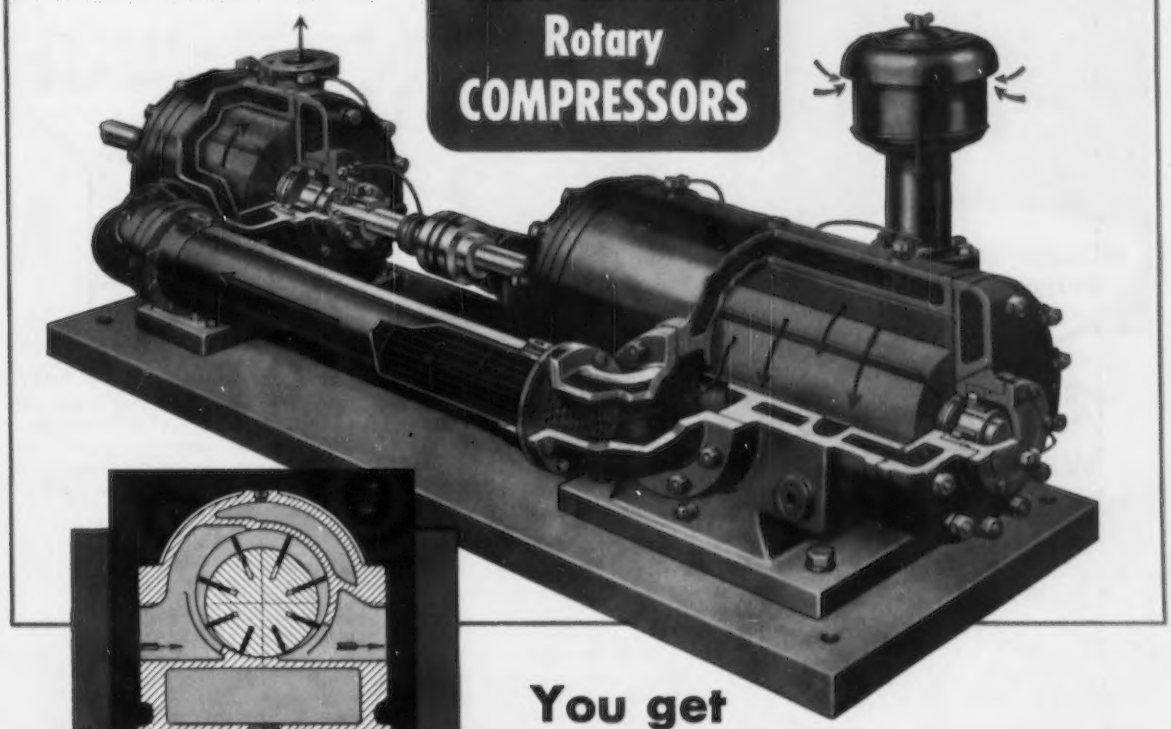


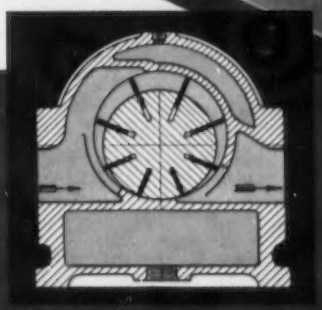
Percussion Bit **(19)**

Especially designed for I-R Quarrymaster rock drills, 6-in. Rok-Master has been added to line of percussion bits offered by Brunner & Lay Rock Bit Corp., Franklin Park, Ill. Threads are 2x3 API. Carbide inserts are used.

ALLIS-CHALMERS

Rotary COMPRESSORS





HOW *RO-FLO* UNITS OPERATE

Centrifugal force moves blades to outside wall to form air chamber.

You get MORE ADVANTAGES with *RO-FLO* units for shop air, drilling, gas handling

TYPE and SIZE for EVERY NEED

Both single and two-stage *Ro-Flo* compressors are available. Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm.

Two-stage units in twelve sizes for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage *Ro-Flo* vacuum pumps for vacuums to 0.3 inch mercury absolute, from 22 to 5950 cfm.

Call your nearest A-C office or write for bulletins 16B8244 (two stage) and 16B8126 (single stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

1. **CONSTANT EFFICIENCY**— During operation the sliding vanes of the rotor press against the cylinder wall to form air cells. Even if these vanes wear, the rotating force holds them in contact with the cylinder wall so that efficiency and air flow never change.
2. **LOW-COST FOUNDATIONS**— Smooth rotation cuts vibration. This eliminates need for heavy foundations used with reciprocating-type units. Small units can be bolted directly to the floor. Large units need only a simple slab.
3. **COMPACTNESS**— No extra weight or extra size is needed to dampen vibration. Every inch is devoted to air or gas handling.
4. **LOW MAINTENANCE**— There is no wear and tear from shock and vibration . . . no pistons and valves.

Ro-Flo is an Allis-Chalmers trademark.

A-5028

ALLIS-CHALMERS

INCREASE THE LIFE OF YOUR PREPARATION SCREENS 500%

Kleenslot
WEDGE WIRE
PREPARATION SCREENS

Replace wire cloth in the elimination of blinding. Primary screening of raw 5 x 0 and 6 x 0 coal to remove the ¼ x 0 for dry cleaning is no longer a problem at the four West Virginia plants of the Red Jacket Coal Corporation. Kleenslot Wedge Wire Screens have brought about this efficient change over. Since 1951 they have brought about continuous money saving in material and labor for replacements and have relieved plant operators of the need for frequent inspections to detect blinding and holes in the screen cloth.

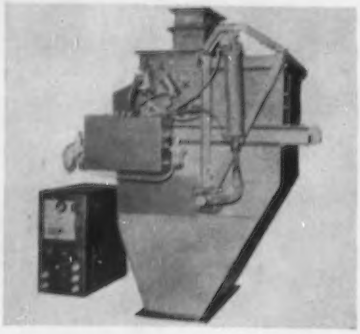
CUT REPLACEMENT COSTS • MINIMUM SHUTDOWN TIME

It costs nothing to obtain a Wedge Wire recommendation. We will gladly furnish this service without obligation. Remember, Kleenslot Wedge Wire Screens are best by every test, so why not specify the best.

Send for free completely illustrated catalog today.

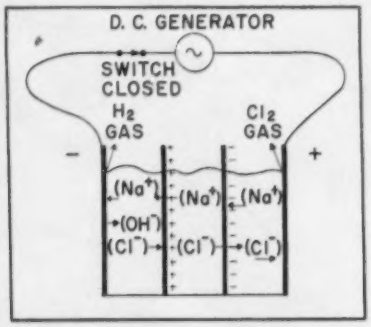
Wedge-Wire CORPORATION
Gas Street at Nickle Plate R. R.
Wellington, Ohio

E&MJ NEW PRODUCTS DIGEST *(Continued)*



Batching Scale (20)

Rotary-type feeder charges gateless tipping weigh bucket—both automatically controlled by electrical-pneumatic devices—on Model 700N batching scale by Thayer Scale & Engrg. Co., Rockland, Mass., for feeding pulverized material.



Water Demineralizer (21)

Electricity and selectively conductive plastic membranes are combined in a multi-cell, continuously operated unit which demineralizes water at considerably lower costs, says Ionics Inc., Boston, Mass. Drawing is schematic.

Mobile Radio (22)

Continuous inaudible subcarrier tone on transmitter signal gives unit-to-unit contact and, together with automatic squelch, makes Private Line radiophone highly efficient even on congested channels, says Motorola, Inc., Chicago, Ill.

Metal Tubing (23)

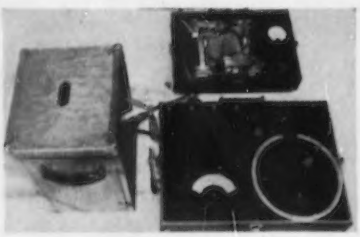
Thin lead-coated steel strip is spiral wound into ⅞- to 2-in. diameter tubing called Titeflex 500. Titeflex Inc., Springfield, Mass., says it is light, strong, corrosion-resistant, easily bent and cut and excellent for ducts.

Blasting Switch (24)

Positive and short timing for seismic work is offered on blasting battery switch called Short Pulse Blaster by Houston Technical Laboratories, Houston, Tex. It comes in compact case.

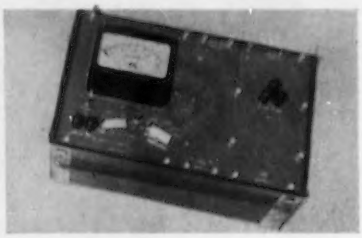
Selective Drive Hub (25)

Latest Lock-O-Matic hub for four-wheel drive vehicles automatically engages front wheels when power is applied yet gives free-wheeling otherwise. Warn Mfg. Co., Seattle, Wash., makes them.



Geophysical Unit (26)

Resistivity survey unit offered by Borden Engrg. Div., M. J. Johnson Aircraft Engrg. Co., Morris Plains, N. J., has Swing Current patented circuit for high sensitivity, it is said.

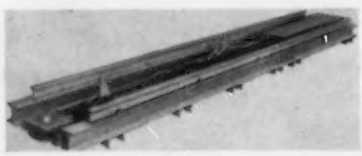


Geophysical Unit (27)

Resistivity survey unit offered by Houston Technical Laboratories, Houston, Tex., is said to have added range and accuracy. Voltmeter and generator each come in similar carrying cases.

Ultra-Violet Lamp (28)

Filter on long-wave ultra-violet lamp, Blak-Ray Model BLF-6, cuts down visible light emission for better observation of pale colors particularly, says Black Light Corp., San Gabriel, Calif.



Car Cagers-Spotters (29)

Requiring little or no excavation, air-operated mine car propellers, as well as other electric and hydraulic models, by Hausherr, are now available from B. J. Nykerk Corp., N. Y.

HOW TO STOCKPILE 25 TONS A MINUTE

Pittsburgh & Conneaut Dock Co. stockpiles a million tons of iron ore during the summer months, to create a reserve supply when ore boats cannot satisfy extreme demands. Four CAT* DW21s with Scrapers handle 1500 tons per hour for this Conneaut, Ohio, firm. That means a DW21 pulls away from the Stephens-Adamson conveyor every minute with a 25-ton load.

This company works two eight-hour shifts, six days a week during the navigation season. Its equipment must do a lot of work fast, and stay on the job. That's why a company official says: "We've had 12 years of experience with Caterpillar equipment. We considered other makes, but found DW21s did the job best."

Now there is a new and improved DW21 (Series C) with 300 HP (maximum output) Turbocharged engine. It has 10% greater rimpull and new, wide-section 29.5-29 tubeless tires for maximum traction. With the big-target No. 470 LOWBOWL Scraper (25-yd. heaped capacity), here's an ideal team for efficient materials handling and for earthmoving jobs in slack seasons. For jobs that are exclusively stockpiling, many firms find that DW21s with Athey haulers pay off.

If you want fast cycle times and traditional Caterpillar stamina, investigate the DW21 today. Your Caterpillar Dealer has full details and on-the-job proof that these big yellow rigs can do more work in less time at lower cost on *your* operation. And count on him for skilled service and parts you can trust.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

Water Demineralizer (30)►

Apparently by some cyclonic effect which "adds energy to atoms," water conditioner by Packard Mfg. Co., Jacksonville, Fla., reputedly prevents scale and corrosion without chemicals or power.

Vibrating Screen (31)

Adjustable angle effected by independent settings of both feed and discharge ends of screen cloth panels, boosts efficiency of UHS vibrating screen, says Deister Machine Co., Ft. Wayne, Ind.

Laboratory Cyclones (32)►

Set of 15 and 30mm Pyrex hydrocyclones, each complete with a range of interchangeable vortex finders and apex nozzles fitting by means of ground glass joints, are offered by Liquid-Solid Separations Ltd., London, England. Test set has capacity of about 4 gpm at 40-psi feed and can make separations to 5 to 10 microns, it is said.

Impact Breaker (33)

For high reduction ratio and cubical particles in primary or secondary breaking of non-abrasive rock, Cuber Senior impact crusher is recommended by Pioneer Engineering Works, Inc., Minneapolis, Minn. It is suitable for stationary or portable installations. Feed opening is 36x48 in. Capacity is up to 350 tph of minus 3 in., 100 tph minus 1 in.

Tractor-Shovel (34)

HO Payloader 2¼-cu yd heaped capacity tractor-shovel is announced by the Frank G. Hough Co., Libertyville, Ill. Many special features are claimed for the unit by the company.

Wheeled Tractor (35)

Claimed as world's most powerful tractor, Twin-C is 416-hp two-diesel unit by LeTourneau-Westinghouse Co., Peoria, Ill. Designed primarily for pushing large scrapers, it weighs over 40 tons.

Tractor-Loader (36)

Scoopmobile LD5T, a 1-cu yd, 2½-ton capacity loader by Mixermobile Manufacturers Inc., Portland, Ore., has 4-wheel steering. Bucket can be carried low for good operator vision.

Tractor Backhoe (37)

Designed for Caterpillar D4, hydraulic backhoe attachment by Hyster Co., Peoria, Ill., has ½-yd capacity, digs down to 13 ft, dumps to 9½ ft and power swings through 240 deg.

Shovel-Crane (38)

K-608, 3-cu yd shovel-crane, is largest production model yet made by Link-Belt Speeder Corp., Cedar Rapids, Iowa. A number of hydraulic controls are incorporated in design.

Tractor Backhoe (39)

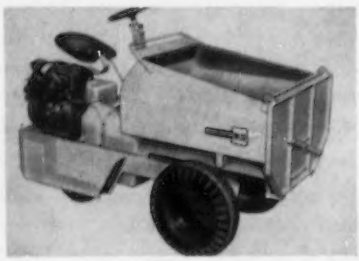
Combination of backhoe and angledozer backfill blade attachment for International 300 tractor, is offered by Wain-Roy Corp., Hubbardston, Mass. It gives a versatile unit.

Pipe Couplings (40)

Gruvajoint gasketed couplings for grooved pipe come in seven sizes, 2 to 8 in. The lighter weight fittings have a number of cost cutting advantages and are Underwriter Lab approved, says Gustin-Bacon Mfg. Co., Kansas City, Mo.

Shop or Lab Tongs (41)

Similar to large device used in atomic installations, Niptongs can be used for handling any hot or toxic materials of small dimension. Insulated handles have lengths of 12 to 48 in. Offered by Atomic Center Inc., N. Y.



Truck (42)

Materials handling truck of 1½-ton capacity with torque converter drive is introduced by Prime-Mover Co., Muscatine, Iowa. Flat bed or 18 cu ft bulk pan with various dumping arrangements are offered. Height with pan is 42 in.

Trucks (43)

An expanded and more powerful line of heavy duty tandem-axle and four-wheel trucks for on- or off-road hauling is announced by GMC, Pontiac, Mich.

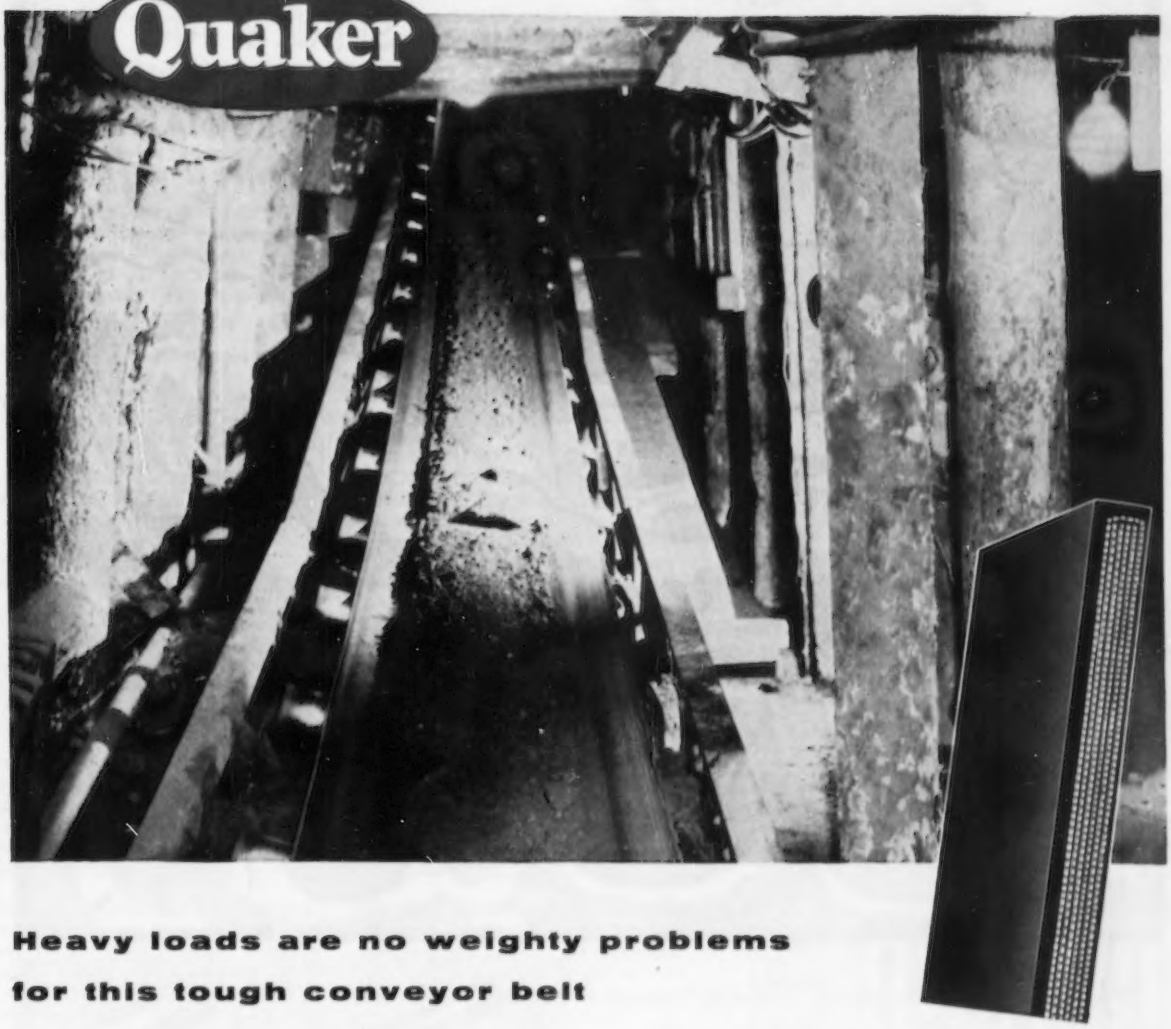
Trucks (44)

Dodge has a line of on- or off-road six-wheelers with V-8 engines up to 220 hp. Weights range up to 65,000-lb maximum gross loaded.

Auto Engine (45)

Two horizontal cylinders each containing two opposed pistons which pump hot gases into turbine for driving wheels, is "free piston" engine in GM's test car.

Quaker



Heavy loads are no weighty problems for this tough conveyor belt

Your Quaker-Quaker Pioneer distributor can supply not only your standard needs—but also your highly specialized ones. You'll find him a prompt dependable money-saving source for everything you need in rubber products. Write for free brochure and name of your nearest distributor.

This highly flexible all-purpose conveyor belt is plenty tough! It has cover tensile strength of 2500 to 3000 pounds average, friction pull of 16 to 19 pounds and multiple-ply carcass of highest quality duck with skim coats between plies. These are reasons why you can count on this belt to stand up to shock impacts of jagged loads, withstand extremes of weather and exposure, and give long, uninterrupted service under the toughest job conditions. Made in any length. Widths up to 72". Also available in the new high tensile cotton and rayon fabrics.

HKP H. K. PORTER COMPANY, INC.

QUAKER RUBBER DIVISION
Philadelphia 24, Pa.

QUAKER PIONEER RUBBER DIVISION
San Francisco 7, California

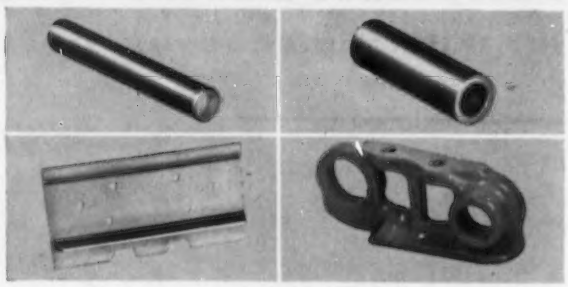
When it comes to parts, don't let "look-alike" substitutes get you off the track.

Genuine Caterpillar track shoes are made of only high-quality rolled steel, specially hardened by an exclusive process. Links are induction-hardened, pretested steel, and their design is the result of years of research and development. CAT* track pins and bushings are also specially hardened, with a deep case and a tough core. You're *sure* you're on the right track with Cat original parts.

With substitute parts, can you be sure of anything?

Better see your Caterpillar Dealer's Parts Representative—and get Cat original parts every time.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.



Caterpillar track parts take the brunt of the punishment when the going is toughest. They are subjected to abrasive sand and gravel, brutal shock loads from stumps and rocks. Why take chances with substitutes?

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

E&MJ NEW PRODUCTS DIGEST *(Continued)*

INDUSTRIAL ENGINES by Caterpillar Tractor Co., Peoria, Ill., now include two heavy duty V-types. Capable of producing up to 650 hp, the 8- and 12-cylinder units are adaptable to various fuels and turbocharging. **(46)**

AC MOTORS for multiple drive arrangement have synchronized variable-speed control in Varidyne system developed by U. S. Electrical Motors Inc., Los Angeles, Calif. Proportional speeds can also be handled. **(48)**

ENGINE-GENERATOR units offered by Lear Inc., Santa Monica, Calif., weigh 35 lb, fit in 1½-cu ft package and supply 1½kw ac or dc. Air-cooled gasoline engine is used. **(50)**

AUTOMATIC TRANSMISSION for small gasoline engines up to 3 hp is controlled by engine speed and has two ranges. Called Trimatic Drive, it is made by Triune Products Co., Dearborn, Mich. **(52)**

WELDING ELECTRODE for building up carbon steel parts prior to hardfacing, is low-cost and is wear resistant in itself, says All-State Welding Alloys Co. Inc., White Plains, N. Y. It is called Roll Matrix. **(54)**

COOLANT for metal cutting, sawing or grinding called Vytron is water soluble chemical that can be suited to wide range of metal hardness by varying strength, according to Vitene Mfg. Co. Inc., Mt. Vernon, N. Y. **(56)**

MEASURING TOOL called Caliputer combines slide-rule, vernier caliper, and vernier depth gage and computer in one inexpensive unit, claims Caliputer, Rancho Santa Fe, Calif. It gives various direct readings for shop use. **(58)**

MAINTENANCE TOOL that frees "frozen" zirc-type fittings is pocket-size hand tool which generates high pressure when struck with hammer. Ram-O is made by Gaskins & Stockman, La Crescenta, Calif. **(60)**

GAS DETECTOR for hydrogen sulphide of Mine Safety Appliances Co., Pittsburgh, Pa., uses hand squeezed rubber bulb to draw air sample into chemical-filled glass tube. Length of discoloration is indicator. **(62)**

DIESEL ENGINES of Series 71 line by Detroit Diesel Engine Div., GMC, Detroit, Mich., now include three Turbopower engines in 4- and 6-cylinder, two-cycle designs which are claimed ideal in on- or off-road trucks. **(47)**

ELECTRIC MOTORS called Linc-Weld have what is termed a unique extruded plastic insulation for 1- to 40-hp sizes. Introduction marks reentry of Lincoln Electric Co., Cleveland, into electric motor field. **(49)**

GASOLINE ENGINE weighing 86 lb and developing 5½ hp is announced by D. W. Onan & Sons Inc., Minneapolis, Minn. Single cylinder is 4-cycle and air cooled. **(51)**

ELECTRIC TIME SWITCH, "more reliable at less cost than predecessor", is announced by General Electric Co., Schenectady, N. Y. TSA-40 has shearing action of contacts which prevents welding and dirtying, it is said. **(53)**

SOLDERING - BRAZING COMPOUND of high silver-content alloy blended with special flux in convenient "paint-on" paste form is available from Eutectic Welding Alloys Corp., Flushing, N. Y. It eliminates shims. **(55)**

ELECTRONIC CONTROL components in 21 "building blocks" can provide "brain" and "nervous" system, use single communication channel and are inexpensive, says Sparks-Withington Co., Jackson, Mich. **(57)**

WELDING ELECTRODE HOLDER called AL-300 Twecotong is made of aluminum and laminated and bonded glass cloth to give low weight and has easy-to-attach cable connection, according to Tweco Products Co., Wichita, Kan. **(59)**

SOCKET WRENCH HANDLE called Proto Rotahead by Plomb Tool Co., Los Angeles, Calif., is said to do work of both reversible ratchet and conventional hinge handle. Downward pressure gives "free-wheeling" effect. **(61)**

SHELVING divided into columnar units and mounted on tracks, cuts aisle space by permitting access to rear shelves simply by sliding front units apart. It is offered by Dolin Metal Products Inc., Brooklyn, N. Y. **(63)**

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card below and mail.

METRIC CONVERSION wall chart issued by Mayo Tunnel & Mine Equipment, Lancaster, Pa., is handy item for shop or office. Face of chart shows some of equipment available. **(64)**

LUBRICATION Newsletter is technical periodical started by Alpha Molykote Corp., Stamford, Conn. Primarily concerned with MoS_2 compounds, it will help keep field in focus. **(65)**

JUNE 1956

NOT GOOD AFTER AUG. 1, 1956 if mailed in U. S. or Canada

Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled.

1	15	29	43	57	71	85
2	16	30	44	58	72	86
3	17	31	45	59	73	87
4	18	32	46	60	74	88
5	19	33	47	61	75	89
6	20	34	48	62	76	90
7	21	35	49	63	77	91
8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	52	66	80	94
11	25	39	53	67	81	95
12	26	40	54	68	82	96
13	27	41	55	69	83	97
14	28	42	56	70	84	98

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13	27	41	55	69	83	97
14	28	42	56	70	84	98

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E&MJ NEW PRODUCTS DIGEST *(Continued)*

WIRE ROPE SLINGS and their safe load at various angles are charted on one page of folder from Macwhyte Co., Kenosha, Wis. Eleven different types of attachments for three body styles are described and illustrated on other pages. **(66)**

WIRE ROPE recommendations for industrial services is a well illustrated booklet put out by Hazard Wire Rope Div., American Chain & Cable Co. Inc., Wilkes-Barre, Pa. Specification for practically every use is given. **(67)**

SUBMERGED COMBUSTION—submerging flame in liquid to be heated rather than applying it to outside of container—is not new, but it is of current interest. Bulletin on method and equipment is by Ozark-Mahoning Co., Tulsa, Okla. **(68)**

WELDING procedures for every base metal are available in 140-page Pocket Data Book from Eutectic Welding Alloys Corp., Flushing, N. Y. Torch and arc welding, brazing and soldering, and use of accessories are covered. **(69)**

METALLURGICAL CARBON is briefly discussed in one page technical bulletin issued by Barnebey-Cheyney Co., Columbus, Ohio. Specifications for their line are given in table. **(70)**

END-DUMP TRUCKS of elevating type are compared to Movall ejecting type in folder from C&D Div., Yuba Manufacturing Co., Perkins, Calif. Nice point-by-point rundown is given in chart-like form. **(71)**

PHOTOSENSITIVE ALUMINUM PLATES and photographic chemicals are detailed in four-page condensed catalog from Metalphoto Corp., Cleveland, Ohio. Trial kit for experimenting with product is available. **(72)**

MAGNIFIERS for a variety of uses—including reading maps or examining minerals—hand held or mounted on stand, are shown in 5-page folder-catalog from Apex Optical Corp., Providence, R. I. **(73)**

CRANES, overhead travelling bridge type, are described in well illustrated catalog from Dominion Bridge Co. Ltd., Montreal, Can. Duty classification is used and each element is discussed separately. **(74)**

DRAG SCRAPERS are covered very well in catalog available from Sauerman Bros. Inc., Bellwood, Ill. Hoists and buckets as well as accessories are specified. Examples of applications and illustrations are excellent. **(75)**

RUBBER PRODUCTS for construction industry is catalog from Boston Woven Hose & Rubber Co., Boston, Mass. Items covered apply to mining too—belting, V and conveyor; hose for air, steam, water, dredge and concrete; et al. **(76)**

SCREEN PLATE & SHEET from Chicago Perforating Co., Chicago, Ill., is available with almost any conceivable shape and size of hole in any kind, size or shape of metal. Descriptive sheet lists basic specifications. **(77)**

ELECTRIC CABLE TROUGHS called Globetray are covered in catalog which shows typical applications. They are made of grating-type material by Globe Co., Chicago, Ill., and designed for easy installation. **(78)**

ELECTRICAL DISTRIBUTION equipment and components for up to 600 v are presented in 160-page catalog for 1956-57 issued by General Electric Co., Plainville, Conn. It contains price list and applications. **(79)**

METAL STRUCTURAL SYSTEM of Stran-Steel Corp., Detroit, Mich., is modular, has nailable features, and minimizes welding. Several types of beams, columns, wall and deck panels are all described in catalog. **(80)**

ROLLER BEARINGS called Shafer Self-Aligning are described in 72-page catalog published by Chain Belt Co., Downers Grove, Ill. Units use concave rollers and concave raceway. Calculations for user are explained. **(81)**

DUMP TRUCK bulletin covering design and operating features of R-15 rear-dump Euclid is offered by Euclid Div., General Motors Corp., Cleveland, Ohio. Rated payload is 15 or 18 tons depending on tires. It is an off-highway unit. **(82)**

QUARRY DRILL, Drillmaster by Ingersoll-Rand Co., N.Y., is treated in 32-page bulletin. Performance data and various mountings of percussion and/or rotary units, including down-the-hole percussion drill, is given. **(83)**

JAW CRUSHERS, overhead eccentric type, from Morgardshammars Mek Verstads Ab., Sweden, are claimed largest in world. Sizes go to 55x71 in. Called Boulder Crushers, they are described in folder. **(84)**

INDUSTRIAL FILTERS available from R. P. Adams Co. Inc., Buffalo, N. Y., fit many grades of liquid and gas filtration. Tubular units are backwash cleaned in several ways, one automatic without stopping flow. Bulletin is offered. **(85)**

SCREEN HEATERS is topic of bulletin available from F. R. Hannon & Sons, Canton, Ohio. It briefly describes advantages of heating and shows their unit. **(86)**

TRUCK SERVICING costs are attacked by methods shown in bulletin on air and electrical Impactools by Ingersoll-Rand Co., N. Y. **(87)**

(PLEASE GIVE THIS ADVERTISEMENT TO YOUR BLASTING FOREMAN)

I'm using Primacord

"You understand . . . I don't *like* thunderstorms. No blaster does. But ever since that job in Kentucky when a direct hit failed to detonate Primacord, I make it a point to use this detonating fuse during the thunderstorm season."

Here's the reason. Primacord is an insensitive detonating fuse. It is not affected by stray electrical currents. It cannot be set off by friction, sparks or ordinary shock. It must be detonated with a blasting cap.

Primacord is used to detonate the entire load in each hole, and to connect all holes in planned sequence to produce *good digging*. A detonating cap is attached to the Primacord only after everything is ready . . . when men and machines are out of the danger zone.

Use Primacord wherever there is danger of stray electrical currents — and particularly during thunderstorm seasons.

For more information see your Explosives Supplier, or write to

THE ENSIGN-BICKFORD COMPANY
Simsbury, Connecticut

Primacord — Quarrycord — Ignitacord® Safety Fuse — Blasting Accessories
Established 1836

To connect a Branch Line of Plastic Reinforced or Plastic Wire Countered Primacord with the Trunk Line

use this DOUBLE HITCH in the textile-covered Primacord Trunk Line. *Draw it up as tight as you can, and make sure that the Branch Line leads off at a RIGHT ANGLE to the Trunk Line.*

PRIMACORD®

DETONATING FUSE

PROVED AND APPROVED

P-21

Cut the Primacord off the Spool Immediately

Make this a safety habit! As soon as you have taken off the length of Primacord you need for a down-hole or for a trunkline, *cut it off the spool! Don't waste a second — do it now!*

To connect the Detonator with the Primacord Trunk Line

use FRICTION TAPE. You can detonate Primacord with fuse and cap or electric blasting cap. Lay the cap alongside of the Primacord with the business end of the cap pointing in the direction that the Primacord will detonate. Tape the two snugly together, so that you have a tight connection.

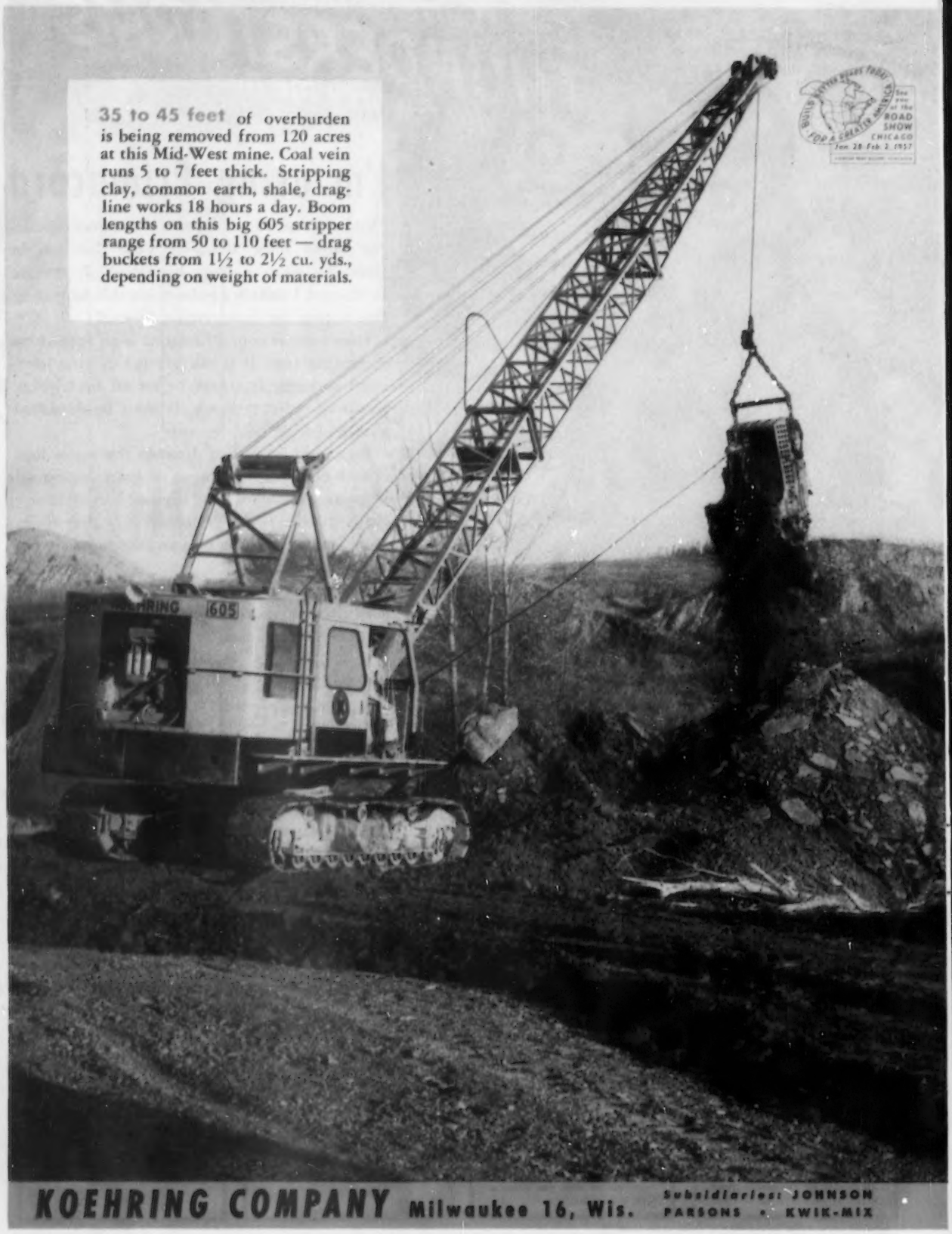
To connect a Branch Line with the Trunk Line

Use this HALF HITCH for Plain and Reinforced Primacord. *Draw it up as tight as you can, and be sure the Branch Line leads off at a RIGHT ANGLE to the Trunk Line.*

To lengthen a Trunk Line

of Plain or Reinforced Primacord, tie a SQUARE KNOT. *Draw it up as tight as you can — it won't slip back. Caution: don't use any knot in a hole — it might break or hang up explosives when loading.*

KOEHRING WORK CAPACITY *in action . . .*



35 to 45 feet of overburden is being removed from 120 acres at this Mid-West mine. Coal vein runs 5 to 7 feet thick. Stripping clay, common earth, shale, dragline works 18 hours a day. Boom lengths on this big 605 stripper range from 50 to 110 feet — drag buckets from 1½ to 2½ cu. yds., depending on weight of materials.

See you at the ROAD SHOW CHICAGO Jan. 28-Feb. 2, 1957

KOEHRING COMPANY Milwaukee 16, Wis. Subsidiaries: JOHNSON • PARSONS • KWIK-MIX

Meet the 405 — new heavy-duty leader in the 1-yard class. Operators like its ease of control, big power clutch, automatic traction brakes, and simple 2-shaft design of upper machinery. *You'll* like its big work capacity with all attachments: 1-yard shovel or hoe, 1 to 1½-yard clam or dragline, 20-ton crane.

Pan-handler — In an Eastern quarry, slabs of sandstone are palletized on pans for quick pick-up, and loaded on trucks. Pans weigh an average of 3½ tons — an easy lift for the Koehring 205 truck crane. Constantly moving to various piles around the quarry, it easily loads 24 pans an hour, according to quarry foreman. With this mobile 205 crane they are equipped to handle loads up to 15 tons.

At rail siding, 305 clamshell crane speeds transfer of material from gondola cars to trucks. Its fast swing and wide work radius pay off on any material-handling. This heavy-duty 305 is another in a modern, new series of Koehring extra-capacity excavators and cranes. Look them over. They're all listed in accompanying chart.

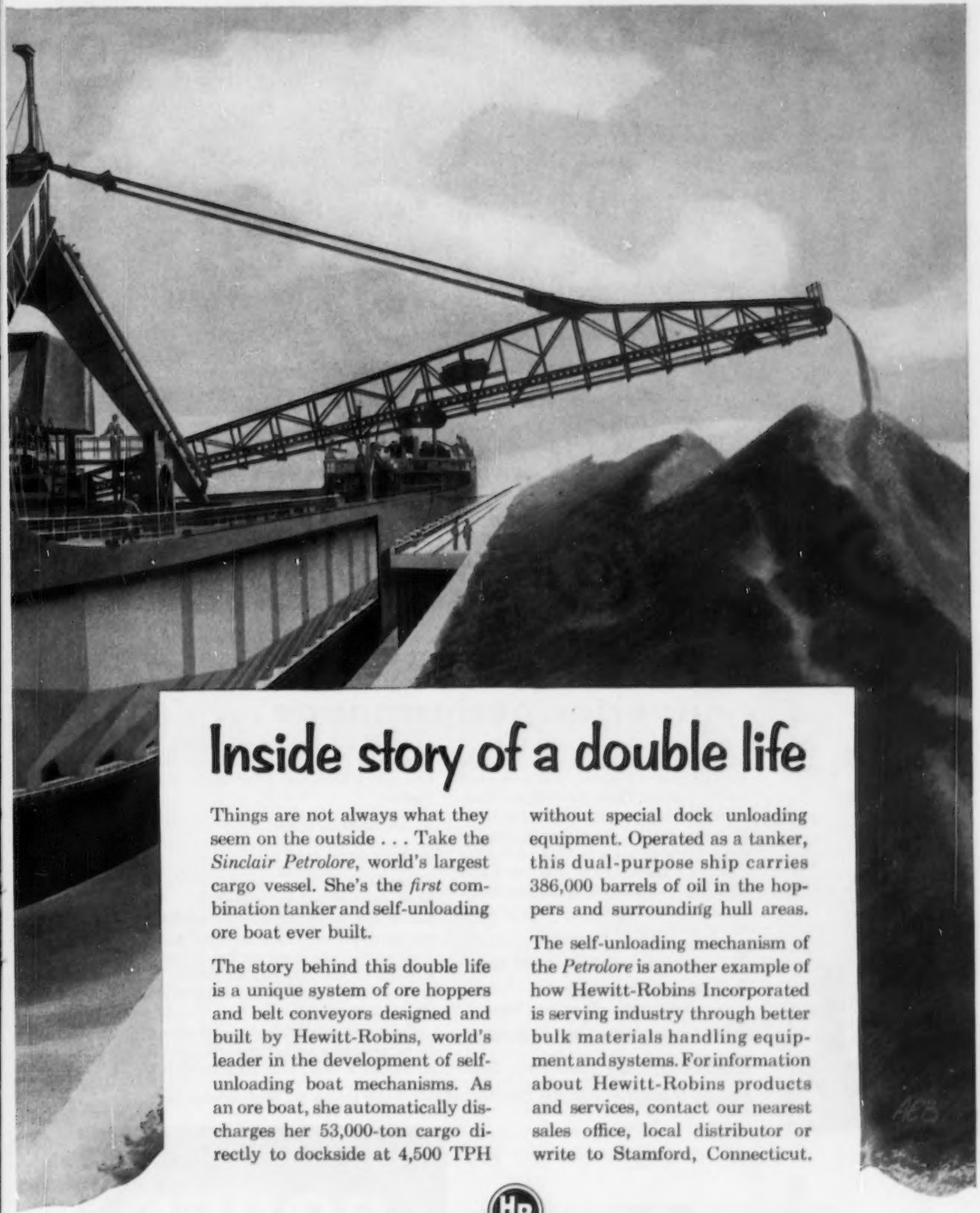
Here are some figures that will interest you:

KOEHRING MODEL	SIZE DIPPER	LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load.)	
205 CRAWLER	½-Yd.	20,000 lbs.	at 10-foot radius
205 ON RUBBER	½-Yd.	30,000 lbs. 13,700 lbs.	at 12-foot radius at 20-foot radius
305 CRAWLER	¾-Yd.	30,000 lbs.	at 12-foot radius
305 ON RUBBER	¾-Yd.	50,000 lbs. 15,800 lbs.	at 10-foot radius at 30-foot radius
405 CRAWLER	1-Yd.	40,000 lbs.	at 12-foot radius
605 CRAWLER	1½-Yds.	72,300 lbs.	at 12-foot radius
1205 CRAWLER	3-Yds.	190,000 lbs.	at 13-foot radius

Want more information? Call Koehring distributor today.

K694

CONVEYOR BELTING and MACHINERY • INDUSTRIAL HOSE • VIBRATING EQUIPMENT • DESIGN, MANUFACTURE,



Inside story of a double life

Things are not always what they seem on the outside . . . Take the *Sinclair Petrolore*, world's largest cargo vessel. She's the *first* combination tanker and self-unloading ore boat ever built.

The story behind this double life is a unique system of ore hoppers and belt conveyors designed and built by Hewitt-Robins, world's leader in the development of self-unloading boat mechanisms. As an ore boat, she automatically discharges her 53,000-ton cargo directly to dockside at 4,500 TPH without special dock unloading equipment. Operated as a tanker, this dual-purpose ship carries 386,000 barrels of oil in the hoppers and surrounding hull areas.

The self-unloading mechanism of the *Petrolore* is another example of how Hewitt-Robins Incorporated is serving industry through better bulk materials handling equipment and systems. For information about Hewitt-Robins products and services, contact our nearest sales office, local distributor or write to Stamford, Connecticut.

HR

HEWITT-ROBINS

ENGINEERING and ERECTION of BULK MATERIALS HANDLING SYSTEMS • "GLIDE-RIDE" the NEW MOVING SIDEWALK

The modern Conveyor Pulley for superior performance . . .

One tough application after another proves beyond doubt that you can't beat a lagged, Taper-Lock Steel Conveyor Pulley for the hard jobs! Here is the score on their use in rugged coke plant service. In this particular case the installation was on belts from the quencher and loading belts to cars. The report was made after *three years of use.*

1. **One-third saving on initial cost.**
2. **Saving on maintenance; no redressing of pulley faces.**
3. **No appreciable wear on lagging.**

In addition, these Taper-Lock Steel Conveyor Pulleys provide the further benefits which are inherent in their design:

1. **No bolts to shear.**
2. **Easy on — easy off.**

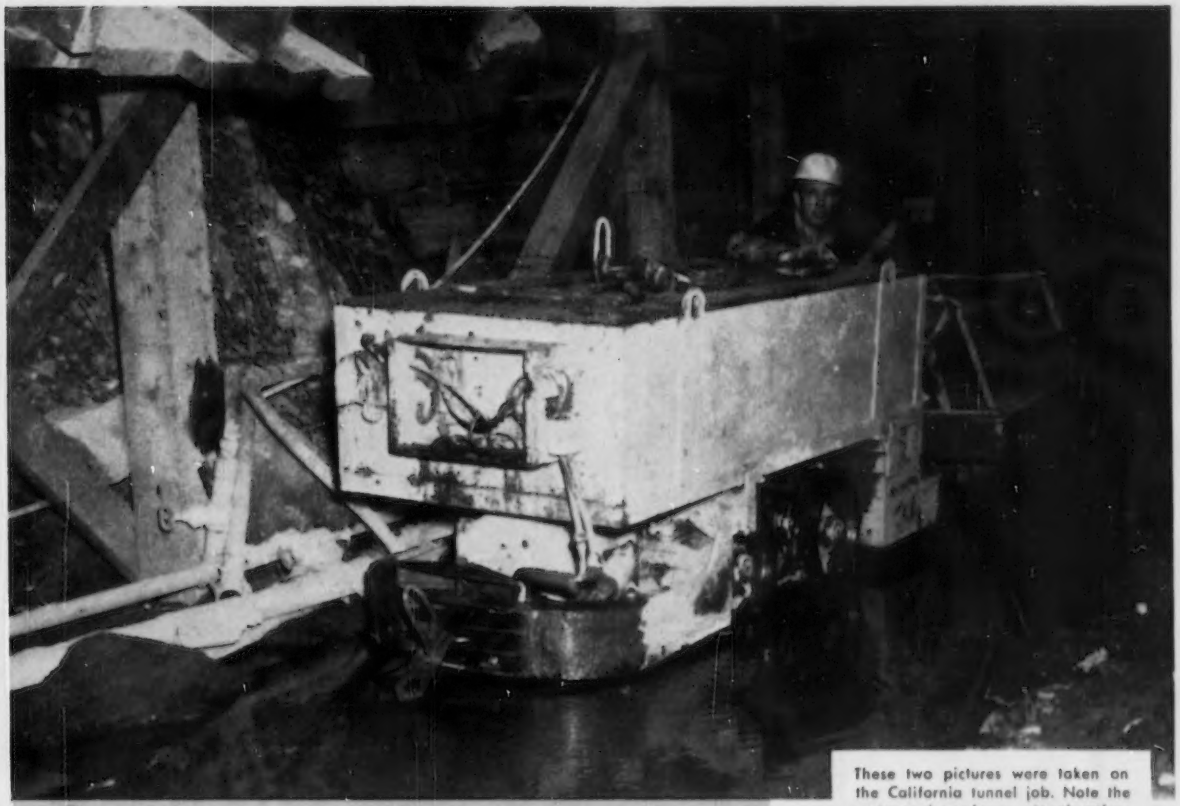
Taper-Lock Steel Conveyor Pulleys have terrific impact capability. All welds are made by the submerged arc process for 100% strength. Taper-Lock's patented back-up bar permits a weld of the full rim thickness to give 100% penetration. And there are no bolts to give way!

Normally available from stock in all face widths and diameters from 6 inches to 8 feet. *Write for bulletin.*

DODGE MANUFACTURING CORPORATION, 3100 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER your local Dodge Distributor. Factory trained by Dodge he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Equipment" or write us.

DODGE
of Mishawaka, Ind.



2 Mancha locomotives... 14 years...1 mine...3 tunnels

These two pictures were taken on the California tunnel job. Note the water and gumbo . . . tough going, but not too tough for a Mancha.

The records show that 13 Manchas, including two Mancha 4-ton Titan A Storage Battery Locomotives, were installed in a mine development in 1942 as part of the Federal metals procurement plan.

At the termination of this project the two Titans were then used on 3 successive tunnel jobs—by Morrison-Knudson Company in Wyoming, by Grafe-Callahan Construction Company in Colorado, and by A. J. Cheff Construction Company in California.

There's a story of service . . . tough, grueling service. Tunnels must be driven on line . . . no detours around bad ground or water courses. And since assigned grades must be maintained, drainage is often inadequate resulting in poor track conditions.

Manchas are built to operate dependably under such difficulties. Extra horsepower insures continuous service without motor failures. Direct connected axles provide positive start and acceleration on wet, slippery rails. Gears are protected from muck and water by a cast steel case with 3" clearance above rails. And the narrow Mancha design permits operation where timbering or airlock doors limit dimensions.

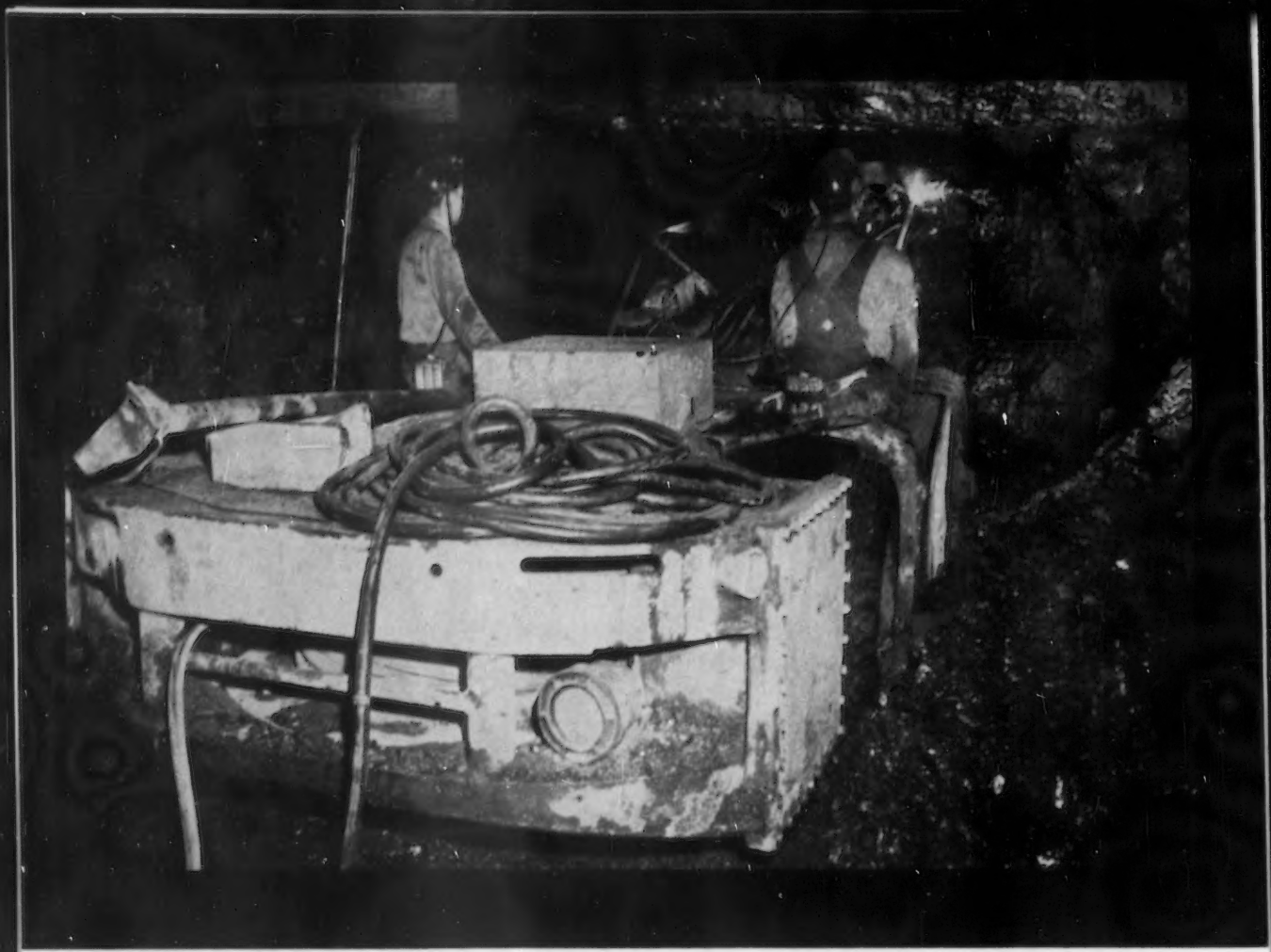
There you have a lot of good reasons for specifying Mancha when you buy your next locomotives. There's a Mancha type and size to meet every need. Write today for catalog.

MANCHA STORAGE BATTERY LOCOMOTIVE

DIVISION GOODMAN MANUFACTURING COMPANY

Halsted Street and 48th Place • Chicago 9, Illinois • Cable Address: Mancha, Chicago

Mancha representatives are located in principal mining areas throughout the world.



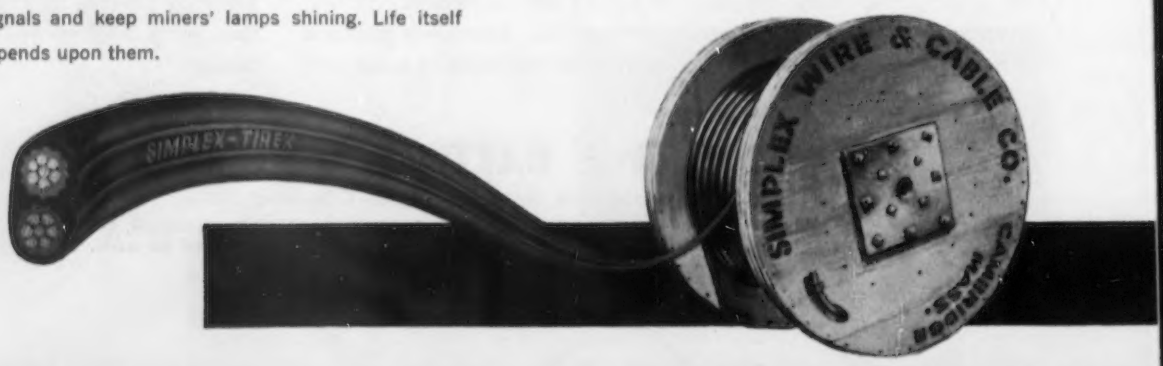
Putting electricity where it's needed:

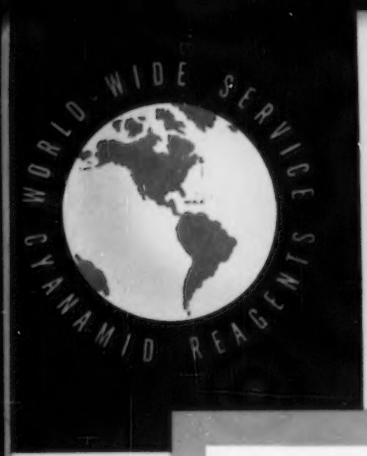
Wherever man's energy is being spent in industry, man must use the power of electricity. Mining men demand that this power be delivered efficiently and SAFELY.

This insistence on top quality and top performance explains the tremendous popularity of Simplex-TIREX cords and cables. You see them in and around mines everywhere, performing dependably in a variety of applications. These cords and cables pour energy into drills, loaders, cutters, feeders, shuttle cars and locomotives. They transmit track signals and keep miners' lamps shining. Life itself often depends upon them.

Simplex-TIREX performs ruggedly,—even under the most trying conditions. Featuring CURED-IN-LEAD SELENIUM NEOPRENE ARMOR, they are engineered to resist abrasion, oil, flame and water.

Simplex-TIREX bears the molded markings of BM and P-101 on its jackets and is made in a wide range of sizes. Be sure to specify Simplex-TIREX when you order cords and cables. **SIMPLEX WIRE & CABLE CO.,** 79 Sidney St., Cambridge 39, Massachusetts.





CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

How Gold Mines Benefit by Using AEROFLOC® *Reagents*

Below are three verbatim reports by a Cyanamid Field Engineer on the use of AEROFLOC Reagents to improve thickening and filtration, as observed at several African mines:

"At_____Mines where weathered surface ore is treated, AEROFLOC has made improvements sufficient to put this operation on a paying basis. They use both AEROFLOC 548 and 3000 Reagents and now get a practically crystal-clear thickener overflow. This has radically improved clarification which previously gave endless trouble. Precipitation efficiency is remarkably good, zinc consumption has been greatly reduced, bullion improved and precipitate smelting costs are lower. In this section alone savings practically paid for the AEROFLOC. In addition, they have been able to rearrange the counter-current decantation plant to get four stages instead of the previous three".

"Use of 0.02 lb. per ton AEROFLOC 548 Reagent at_____Mining Co. Ltd. has made it possible to treat 300,000 tons of surface ore previously considered to be so hard to settle as to be untreatable. After grinding, their pulp goes to bowl classifiers. The rake product is leached and the overflow cyanided after thickening. At first they added AEROFLOC 548 Reagent to the bowl classifier but got better results when it was added to the thickeners which treat the bowl classifier overflow".

"As you know,_____is a small property recovering gold by amalgamation and cyanidation. They increased the rate of sedimentation by 25% and reduced gold losses, too, by adding 0.01 lb. per ton AEROFLOC 3000 Reagent to the thickeners (after amalgamation and prior to cyanidation). Filtration rate has been increased to a point where they get by with one drum filter instead of two. Their books show that AEROFLOC costs a penny a ton whereas increased recovery alone is four pence worth of gold per ton".

These are typical of reports of results on gold operations the world over. A Cyanamid Field Engineer will be glad to help you benefit by using AEROFLOC Reagents to improve thickening and filtration. A phone call or letter to our nearest office will get prompt attention.

AMERICAN CYANAMID COMPANY

MINERAL DRESSING DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Cable Address – Limenitro, New York

NORTH AMERICAN CYANAMID LIMITED
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IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.

take a good look at the Walworth "500 Brinell" no. 225P Globe

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

note these 7 Great Features

HEXAGONAL UNION BONNET CONNECTION: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,200 psi.

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

ON EVERY OFF-THE-ROAD JOB . . .

GENERAL

gets the work done *FASTER* at *LOWEST* cost!

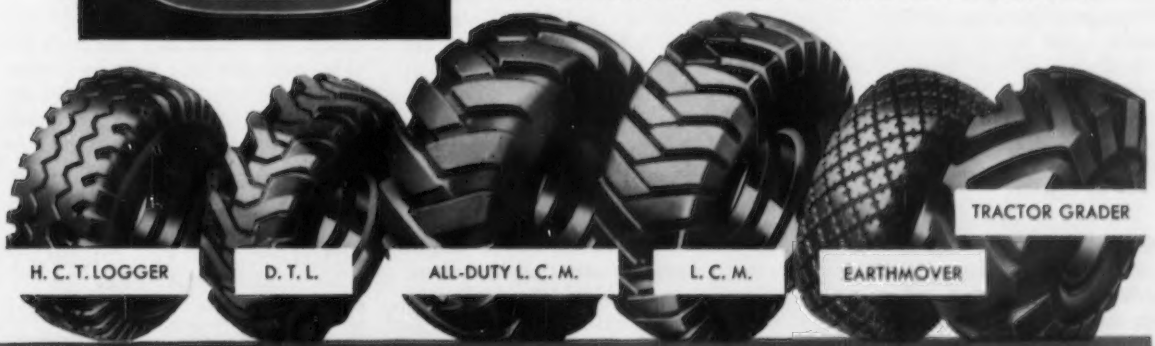
ONLY GENERAL GIVES YOU STRONGER-THAN-STEEL NYGEN® CORD FOR EXTRA PROFIT ON THE JOB!

Every hour of every day, in quarries and strip mines, on logging and construction jobs the nation over, The General Tire proves its reputation for toughness, strength and dependability.

Delivering deep-down driving traction and high flotation *plus* Nygen Cord protection against job hazards, The General Tire continues to get the work done faster at lowest cost wherever it operates!

THE GENERAL TRUCK TIRE

Specify GENERALS *on your new equipment*



THE GENERAL TIRE & RUBBER COMPANY · *Akron, Ohio*

How soon will the Yieldable Arch start saving money for you?

Install Bethlehem Yieldable Arches in your mine, and they'll probably maintain their structural integrity throughout the service life of the shaft. And when you figure the initial cost of the Yieldable Arch against the cost of frequent timber replacements, you'll readily understand why so many mining men say the arch pays for itself in its first year of service.

On top of that, you'll find it a simple matter to take down the arches and re-use them at other locations. You have good reason to expect 100 pct recoverability!

The Yieldable Arch is made up of rolled-steel segmental sections which are heavily flanged to resist buckling and torsional stresses. One segment nests inside another in an overlapping joint. Rugged U-bolt clamps, used in pairs to secure the joint, are drawn up tightly enough to hold fast under normal loads.

However, when unusual pressures begin to bear down, the joints can give sufficiently to relieve the load. Thus safety underground is maintained.

Each arch set is tied to its neighbor through a series of horizontal braces, to provide lateral rigidity in the structure. Timber lagging is usually used, but steel lagging can be furnished if desired. Your own men can install Yieldable Arch sets without special skills or constant supervision.

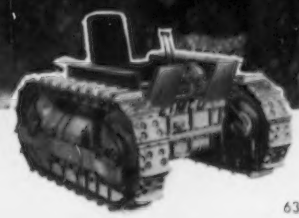
The arches shown in the photograph were especially designed for this particular job; your own mine might well use the standard Yieldable Arch. One of our engineers would welcome a chance to look into the matter with you to see how you might benefit from this new and economical development. How soon?

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

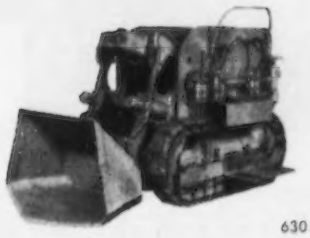
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

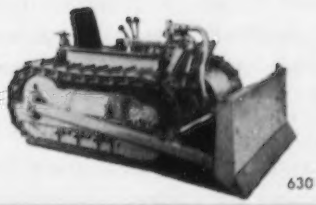
BETHLEHEM STEEL



630 Tractor



630 Excavator



630 Bulldozer

Open stope mining has been the proving ground for numerous types of mechanical loading equipment. One type has replaced another as each succeeding piece of equipment has been able to show greater versatility, greater dependability and lower costs.

Mining men in these fields have been quick to try out any equipment, accept it, remodel it or reject it.

Their reaction to the Eimco 630 Excavator has been enthusiastic. "We're re-ordering on the 630, it's giving us the lowest per ton cost and the highest production."

Eimco 630 Excavators have proven their dependability in mines and on contract jobs. Their heavy-duty construction has made them the lowest cost loaders used underground. They are easily controlled, fast in action and their loading speed averages three tons per minute in rock.

Independent track control on the Eimco 630 provides unusual flexibility for the operator. New features built into the 630 provide the ultimate in operator safety, operator convenience and ease in machine care.

The 630 is a rugged, hard working machine with a tough, carefully designed and precision made operating mechanism.

Lower your loading costs with Eimco equipment. Thousands of Eimcos are working every day wherever mining is done. You can depend on an Eimco.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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EIMCO

B-192

here's a
Wagon Drill that
really gets around!

the G-800 Tracdril

Self-Propelled

One-man Operated

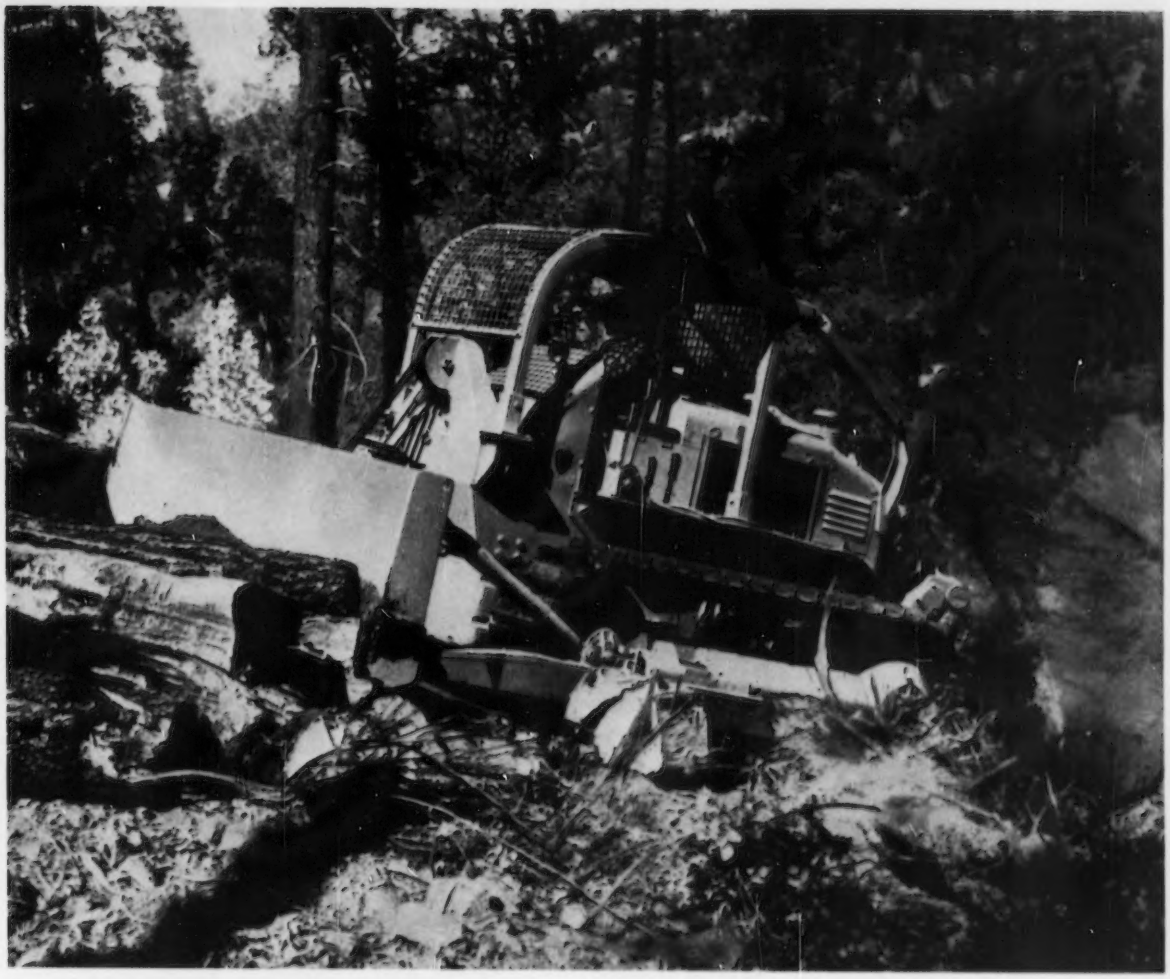
Tows Own Compressor

Combine the drilling speed of the hard-hitting CP-70NDC Drifter with the adaptability of a CP Drill Carriage and U-arm . . . add the maneuverability of a self-propelled track-mounting that tows its own air supply over rough terrain . . . and you have the One-Man CP Tracdril.

Reversible tramming motors enable the Tracdril to go forward, backward and pivot . . . for faster "moving time" from hole-to-hole, more accurate spotting and more time for productive drilling. "Knee-action" tracks keep the hydraulically operated U-arm support level when operating on uneven ground. The Tracdril has plenty of reserve power . . . can tow a 13,000 pound CP 900 c.f.m. Rotary Compressor up a 10% grade. For details see your CP equipment distributor.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



COMPETITIVE TESTS SHOW EIMCO ADVANTAGES

Recent competitive tests have shown again the superiority of Eimco equipment.

Tests conducted in timber and foothill brush were made to determine dozer earth moving and fire line construction ability.

Over a five day period numerous runs were made by impartial crews and judges with experienced operators using an Eimco 105 and a conventional tractor both equipped with bulldozers.

When final results were computed, the Eimco rated "Best" with 33% more dozer earth moving and 11% more fire line construction and the Eimco had also earned operator confidence because it was more stable, easier to operate and would back up 30% steeper grade (the usual method of getting out of trouble).

The features on the Eimco that contributed to its success in the test and outstanding performance under most difficult conditions were: front operator position, better visibility, rear engine mounting, better weight distribution, torque converter, better location and protection of cooling system, better maneuverability (through independent track control) simple controls which eliminate clutch pedals, steering clutch levers, master clutch and manual gear shift lever.

Eimco tractors with bulldozer or excavator attachments are demonstrating their superiority of performance and economy of operation on highways, construction jobs, in mines and in numerous other applications. See the Eimco Tractor before you make any decision on new equipment.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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EIMCO

B-202

Wire rope lasts as long as the wire it's made of!

ROEBLING'S NEW ROPE WIRE

1105

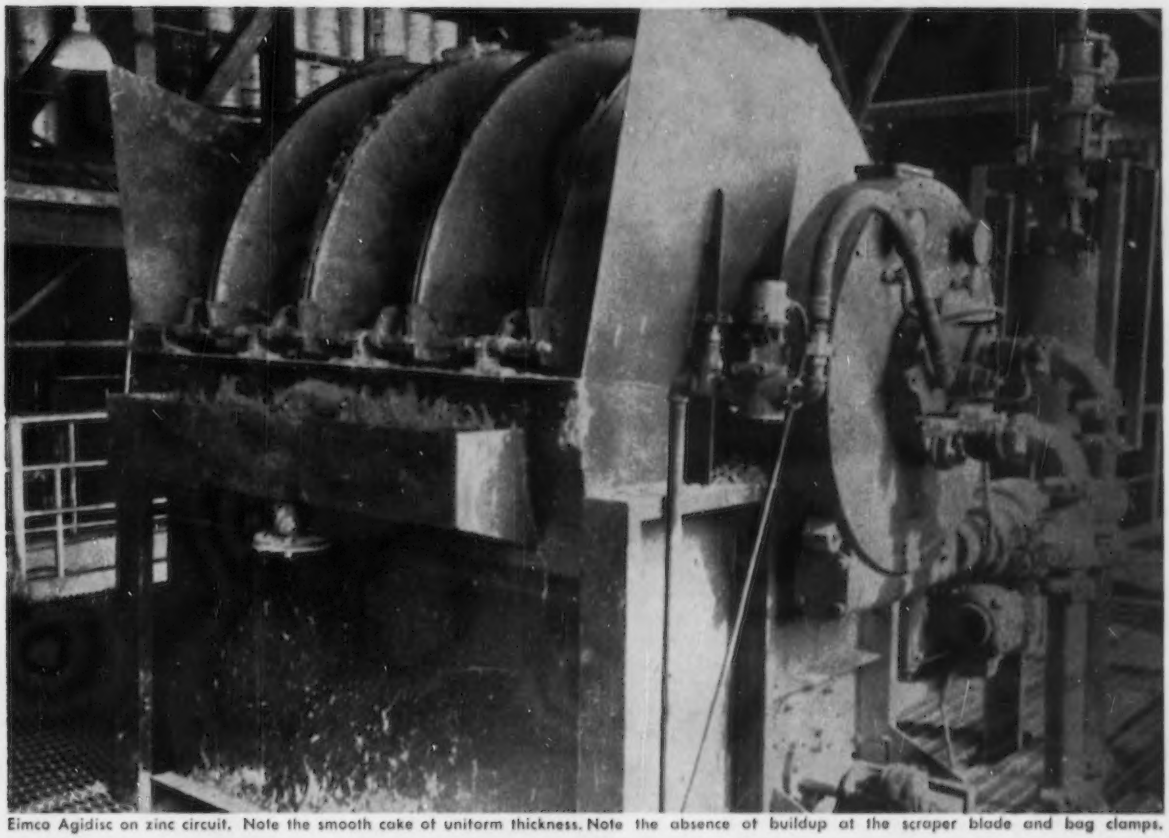
HAS THE CAPACITY TO ENDURE...
AND

Royal Blue

WIRE ROPE
IS MADE OF 1105!

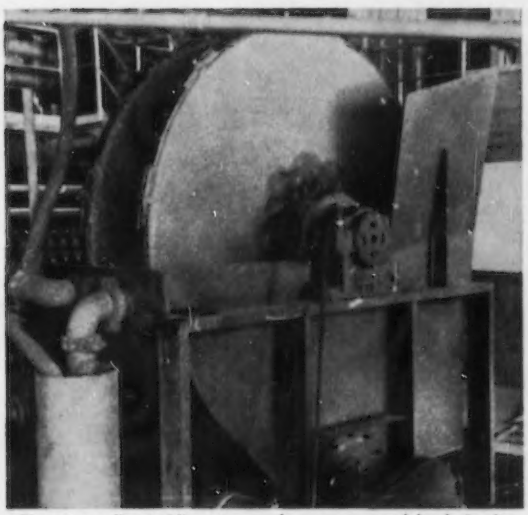
Write us for full facts on the all-steel Royal Blue Wire Rope, or contact your Roebling distributor

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 2353 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, 19 RECTOR ST., NEW YORK 6, N. Y.



Eimco Agidisc on zinc circuit. Note the smooth cake of uniform thickness. Note the absence of buildup at the scraper blade and bag clamps.

LOW MOISTURE AT HIGH ALTITUDES WITH EIMCO AGIDISC FILTERS



Eimco two disc Agidisc type used on copper and lead circuits.

Metallurgical concentrates being dewatered in a mill at approximately 9,000 ft. elevation are handled on three Eimco Agidisc filters, one each for lead, copper and zinc circuits.

The ore is ground to 50%—200 mesh and dewatered on the Agidiscs equipped with snap blow device to provide maximum cloth life and tonnage.

Most important is the moisture content of these dewatered concentrates discharged from the filters at this altitude. The monthly average runs; lead 8.0%, copper 9.5% and zinc 10.3%.

Operation of these filters is best expressed in the words of the Superintendent of the mill who says, "their (Eimco Agidiscs) operation is so trouble-free that we have paid no attention to them and feel that when we get time from the other parts of the circuit we will undoubtedly be able to improve the present moistures."

Your problem in dewatering a metallurgical concentrate can be solved by Eimco's filtration engineers. Call on Eimco for the experience and facilities to solve your problem.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-204

ENGINEERING REPORTS:

Powered by General Electric system . . .

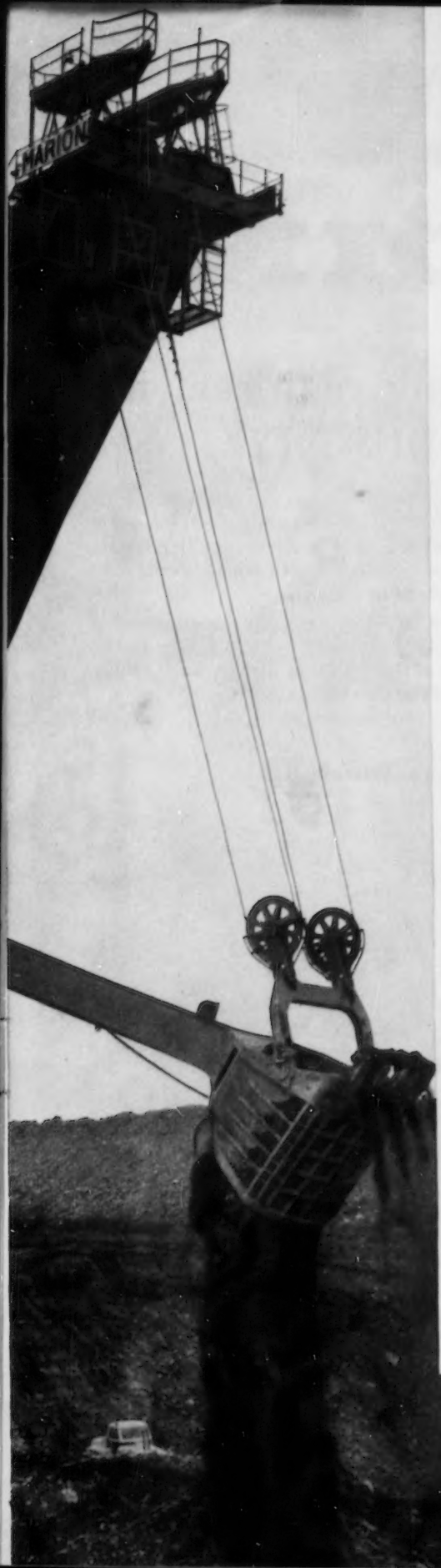
World's biggest shovel removes 90-foot overburden

60-cu yd. Marion shovel permits profitable coal recovery by Hanna at a 20:1 ratio of overburden to seam depth

Speeding production for Hanna Coal Co., Division of Pittsburgh Consolidation Coal Co., *The Mountaineer* now makes possible profitable strip mining of coal from 4½-foot seams under an average 90 feet of overburden. A product of Marion Power Shovel Co., the machine is designed for dependable, round-the-clock, 45-second duty-cycle operation.

Among the highlights of its specially engineered electrical system, designed and equipped by General Electric, are: 14 main G-E motors with total rating of 7500 hp, but actually capable of producing twice that amount—including the largest d-c mill motors ever built; 6.9-kv distribution voltage—a new high for power shovels; and amplistat**-controlled performance.

In any phase of mining, G-E engineering and equipment can combine to help you increase production. For information, call your G-E Apparatus Sales Office, or write General Electric Co., Section 660-34, Schenectady 5, N.Y.



G-E ANALOG COMPUTER enabled engineers of Hanna, Marion, and G.E. to complete in two weeks calculations on design and performance that might have taken three years.

4 RUGGED G-E vertical armored d-c motors, developing 1900 hp, give top performance on high-capacity, heavy-duty swing-motion.

HIGH DEPENDABILITY on a demanding application is provided by four G-E d-c mill motors developing 5000 hp for hoist-motion, equipped with Tri-Clad '55'† blower motors.

SHOCK-RESISTANT G-E armored motors, atop frame, power crowd-motion. Sturdy design helps assure long life on rugged duty.

ABUNDANT DC POWER for operating needs is supplied by two large G-E motor-generator sets. Synchronous motors drive seven generators, which develop 6000-kw peak output.

FINGER-TIP CONTROL of operating functions is provided by adjustable-voltage system with responsive G-E Amplidynes*.

SPEED CONTROL with protection from heavy impact loads during repeated bucket loading, plus simple one-man operation is provided by reliable G-E amplistat control panel.

PROPELLING SHOVEL, four 250-hp G-E wound-rotor motors, powering 8 crawlers, are controlled at second operator station.

*The Amplidyne—rotating amplifier developed by General Electric.
**Amplistat—static amplifier developed by General Electric Co.

†Reg. trade-mark of General Electric Company.

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

Nordberg

GRINDING

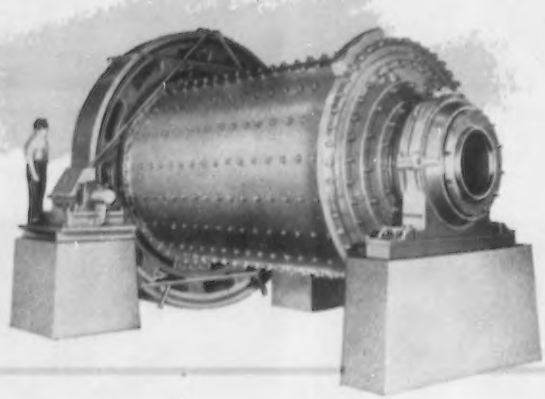
. . . built to meet the exacting requirements of the MINING INDUSTRY

NORDBERG MACHINERY is the result of specialized engineering skills aided by unsurpassed manufacturing facilities. For over half a century Nordberg has produced heavy machinery for the mining industry, which has become well known all over the world for its advanced engineering, excellent construction, high efficiency and dependable service.

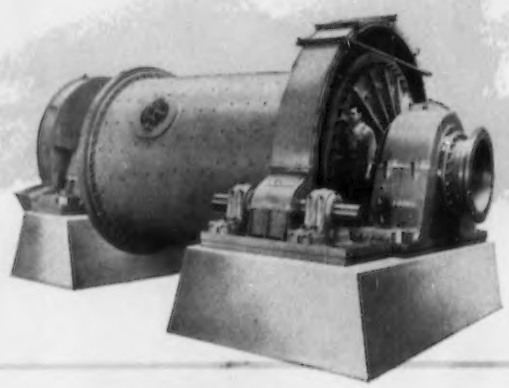
Included in this broad line of heavy machinery is the complete line of Nordberg Grinding Mills, designed and built to meet the most exacting requirements of the mining industry . . . for wet or dry grinding of metallic and non-metallic minerals, and in other processes where friable material must be comminuted to fine sizes.

Nordberg Grinding Mills are manufactured in sizes ranging from 6 to 13 feet in diameter and up to 50 feet in length. Types include Ball, Pebble, Rod, Tube and Compartment Mills.
Write for further information.

NORDBERG MFG. CO., Milwaukee, Wisconsin



• Typical Nordberg dry grinding Rod Mill, measuring 10'-6" in diameter by 16' in length, for ore processing service. Mills of this type are in wide use in the mining industry, delivering maximum output at lowest possible cost.



• View showing discharge end of Nordberg 10'-8" x 17' wet grinding Ball Mill with Scoop Feeder. Whether wet or dry process, open or closed circuit operation, there is a Nordberg Grinding Mill built for the job.

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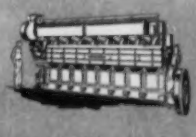
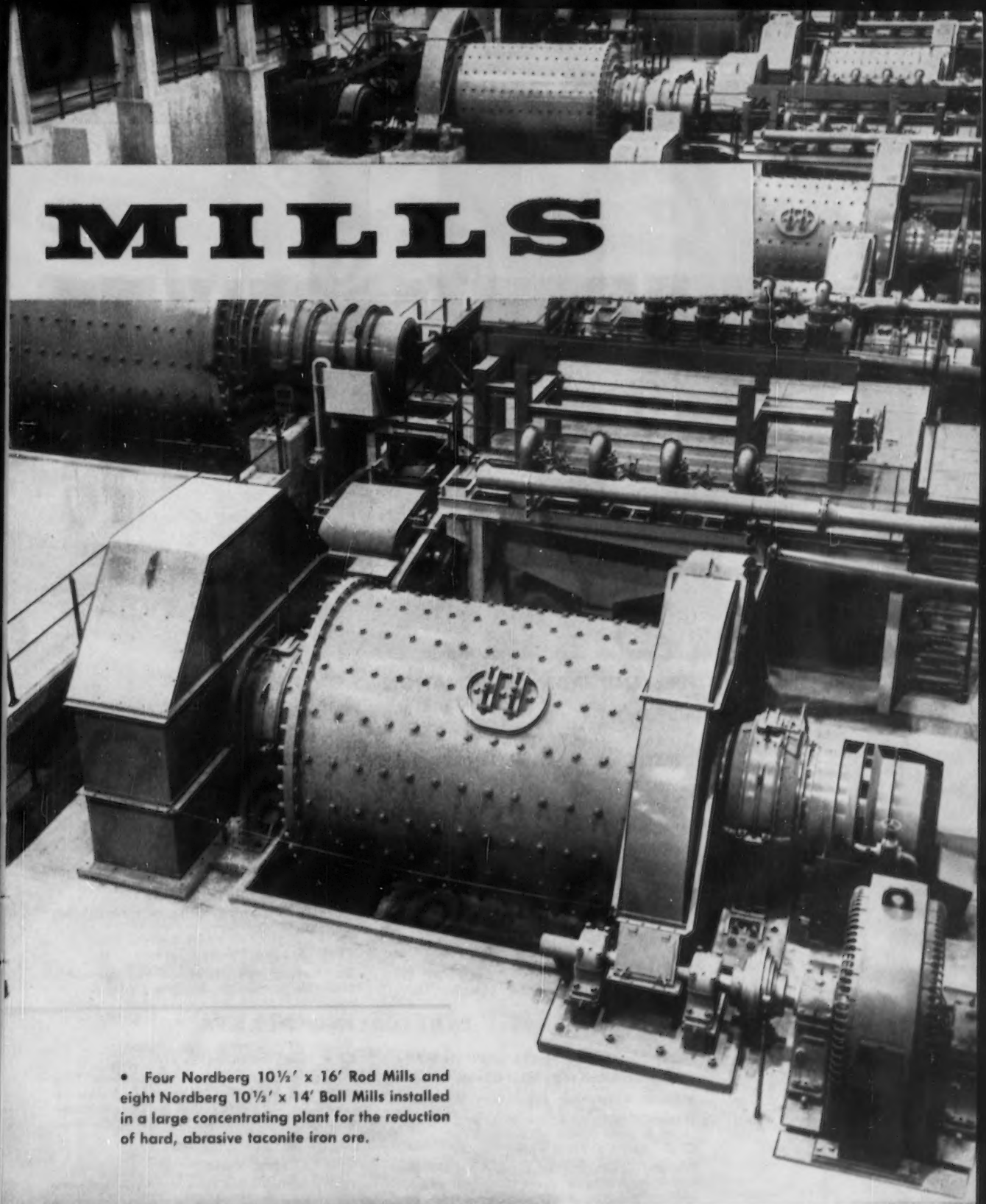


NORDBERG DIESEL • DUAFUEL® and SPARK-IGNITION GAS ENGINES

MILLS



• Four Nordberg 10½′ x 16′ Rod Mills and eight Nordberg 10½′ x 14′ Ball Mills installed in a large concentrating plant for the reduction of hard, abrasive taconite iron ore.

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GM-156

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CF&I Buffalo, New York

Blast Furnaces and Open Hearths producing pig iron, ingots, blooms, billets and rods.

CF&I Claymont, Delaware

Open Hearths producing ingots and steel plate.

CF&I Roebling, New Jersey

Open Hearths producing ingots, blooms, billets and rods.

CF&I Brooke, Pennsylvania

Blast Furnaces producing basic, Bessemer, foundry, malleable and low phosphorus pig iron.

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The quality of CF&I steel products is firmly controlled since the requirements of each product determine the analysis of the steel.

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CF&I Mt. Wolf, Pennsylvania
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CF&I Oakland, Calif.
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CF&I Palmer, Mass.
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CF&I Pueblo, Colo.
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CF&I Roebling (Trenton), N. J.
High and Low Carbon Flat Wire (All tempers, edges and finishes)—Brush, Corset, Casing, Heddle and Drop Wire, Umbrella Wire and Tape Lines—Wire Rope—Strand, Aircord and Fittings—Wire Rope Slings—Electrical Wire and Cable and Magnet Wire.

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3492

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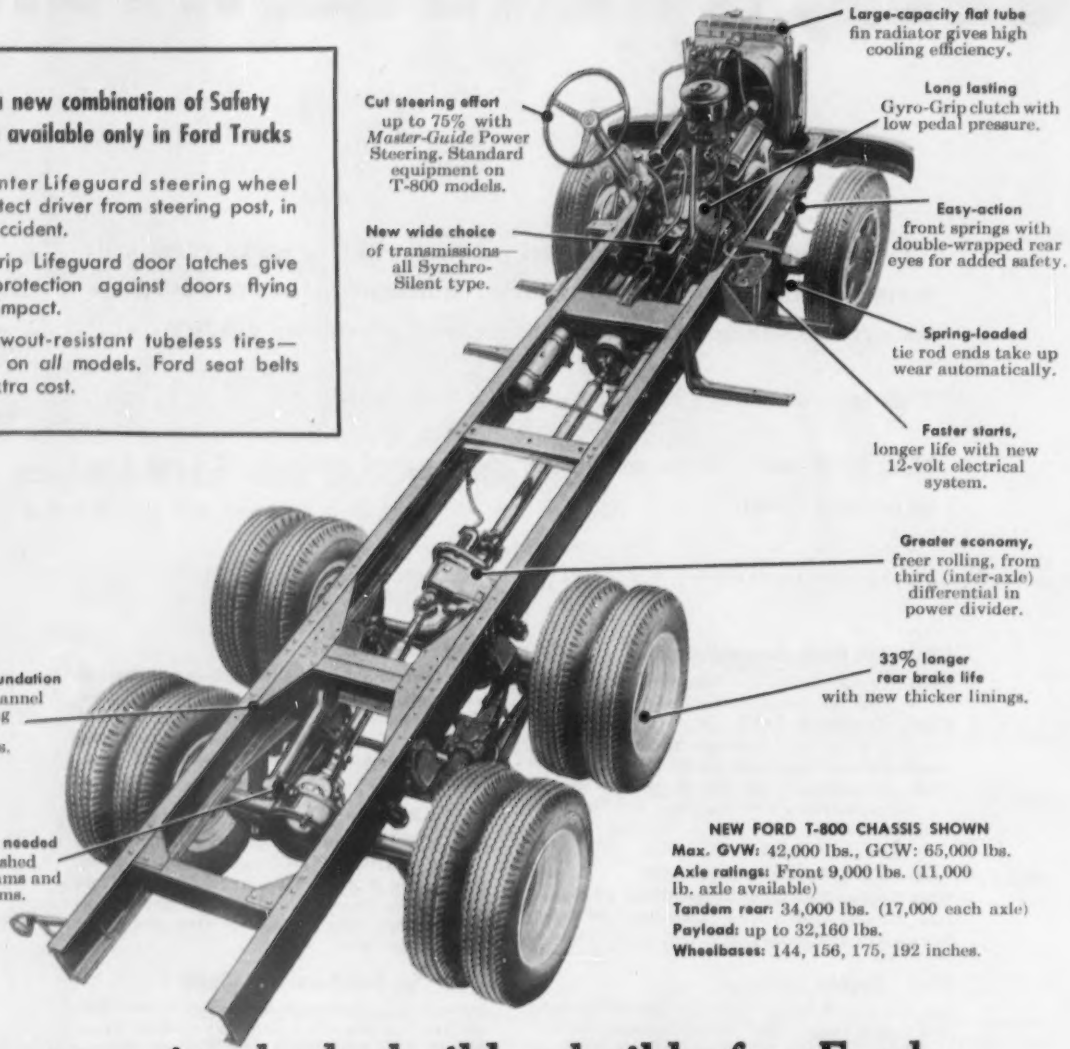
• The new Ford T-800 is a good example of Ford's superior Tandem-Axle BIG JOBS. Lowest-priced tandem of the four leading makes. Up to 3000 more lbs. of payload compared to many other tandems *in the same GVW weight class!*

With a new combination of Safety Features available only in Ford Trucks

Deep-center Lifeguard steering wheel helps protect driver from steering post, in case of accident.

Double-grip Lifeguard door latches give added protection against doors flying open on impact.

New blowout-resistant tubeless tires—standard on *all* models. Ford seat belts at low extra cost.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NEW FORD T-800 CHASSIS SHOWN
Max. GVW: 42,000 lbs., GCW: 65,000 lbs.
Axle ratings: Front 9,000 lbs. (11,000 lb. axle available)
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Payload: up to 32,160 lbs.
Wheelbases: 144, 156, 175, 192 inches.

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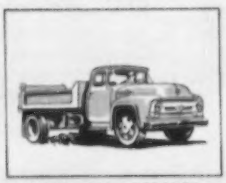
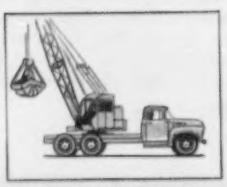
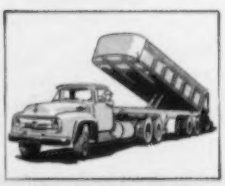
DUMP TRUCK


DUMP WITH SCRAPER


TRUCK-MOUNTED CRANE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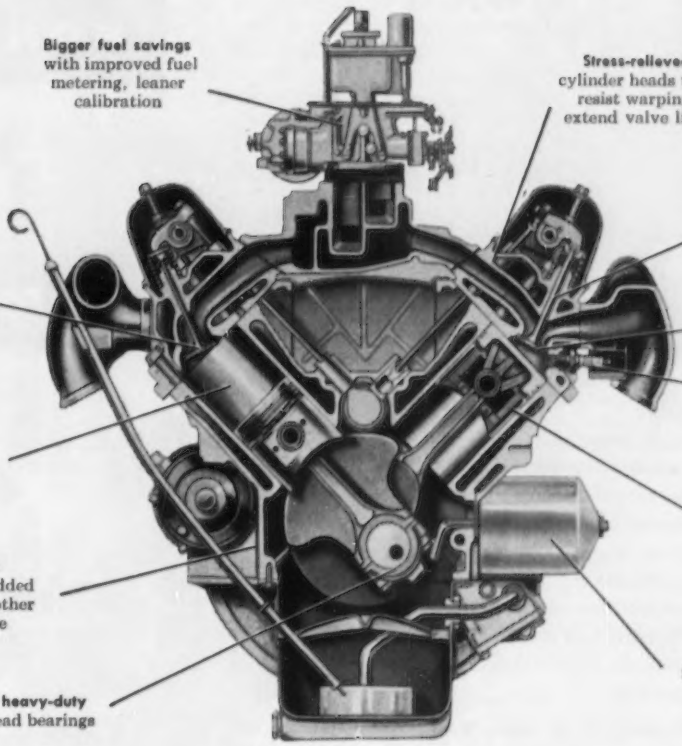
Longer-lived, dependable operation with exclusive heavy-duty engine features

• '56 Ford Tandems offer you the most proven Short Stroke V-8 engines in the industry—*for better gas mileage, longer life, less maintenance costs.* And you get a combination of longer-lasting heavy-duty engine advancements found in no other truck. Ask your Ford Dealer for details.


Bigger fuel savings with improved fuel metering, leaner calibration
Stress-relieved cylinder heads that resist warping, extend valve life*
225° cooler valves —new sodium-cooled exhaust valves with tungsten-cobalt facing*
Self-Sealing dish-type intake valves for tighter fit*
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Short Stroke design in *every* engine for greater gas savings, longer life
Expansion-controlled pistons with integral steel struts
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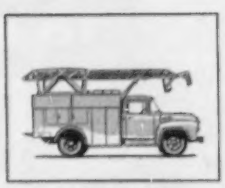
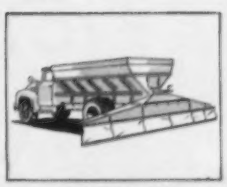
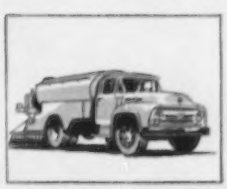
*Features of new Ford Heavy Duty engines . . . 200-h.p. *Torque King* V-8 shown . . . 212-h.p. *Torque King Special* V-8 available.

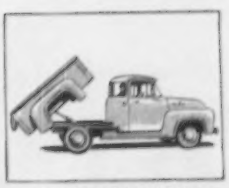
More fleets are buying Fords than any other make

UTILITY TRUCK


LINE TRUCK


LIME SPREADER


BITUMINOUS DISTRIBUTOR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ENGINEERING AND MINING JOURNAL

JUNE 1956

Reaction Is Favorable to AEC's New Program

DOMESTIC URANIUM PRODUCERS have been standing by for AEC to announce a post-1962 uranium purchasing program—and now it's out. AEC will buy uranium oxide in concentrates from mills at $8 per lb after the current buying program expires March 31, 1962. See p 72 for details. The Commission may exercise its option to limit buying to 500 tons of oxide per year from one mine.

Comments by leading uranium producers in reaction to this new program are reviewed on p 72. In general they seem to add up to an expression of relief—one which in effect says "Now that we know where we stand on price, we have five years to plan ahead." Without question the industry will be forced to mine efficiently and without dilution. Mills will have to revamp flowsheets to improve extraction. Watch for an impressive article by AEC metallurgist, W. L. Lennemann, "If You're Planning Uranium Extraction, Take a Look at Today's Flowsheets," which will appear in *E&MJ*'s Mid-June Mining Guidebook. Efficiency, engineering skill and sound mining sense will supplant the boom and promotion in the uranium picture. These are all healthy developments.

In evaluating the new uranium price plan, we must not lose sight of AEC's accomplishments in the past. Under the trying circumstances of critical but secret military demand in the late 40's, the Commission had to urge a reluctant mining industry to get into the uranium business on a profit motive. Price programs were set up to encourage production, and revised as industry problems became apparent. Then came the Steen discovery, and everybody plunged into the business. Now we face a transition from military to peacetime use of uranium. As in the past, the AEC has had to look ahead, and formulate a price structure that will satisfy the taxpayer's interest, provide military needs, and sustain an efficient uranium mining industry to supply industrial requirements.

As a starter, AEC's new program appears sound and businesslike. It reaffirms the Commission's desire to get out of exploration and milling as fast as private industry is willing to pick up the responsibility. Extension of the initial production bonus from next February to March 31, 1960, gives the prospector a chance to explore his present holdings.

If AEC's plan is defective, past performance indicates a willingness of the Commission to make reasonable modifications. Of greatest significance is the provision that uranium producers will be able to sell to private consumers after 1962. If present momentum in reactor development continues, the need could be great.

There's a Limit to State's Rights

JUST ONE YEAR AGO we ran an editorial showing that such countries as Peru, Canada and Southwest Africa which provide a fair and favorable economic climate for venture capital have benefited by such policies; and that other countries which resorted to high taxes and confiscation have suffered economically. We don't have to go out of the United States to study the impact of taxation. If, for instance, Minnesota had levied unrealistic taxes on the new taconite industry, she would have automatically cut herself off from investments which will ultimately total $1½-billion or more.

Now we note an ominous development in Louisiana, where Earl K. Long, brother of Huey Long, has recently taken office as governor. Under a newly introduced bill H.R. 671, the Governor and his strong following would increase the severance tax rate on sulphur from $1.03 to $3 per ton.

If imposed, this tax will be a serious blow to Louisiana's sulphur producers and shut down some of the high-cost properties. The sulphur industry is highly competitive, and a $3 tax would put Louisiana sulphur at a severe disadvantage with sulphur from Texas where the tax is less than half of this amount. Equally serious is the fact that Mexican sulphur production is now having an appreciable effect on U.S. exports. U.S. sulphur exports are expected to fall from about 1.65-million tons in 1954 to less than 1-million tons in 1956, largely due to Mexican exports.

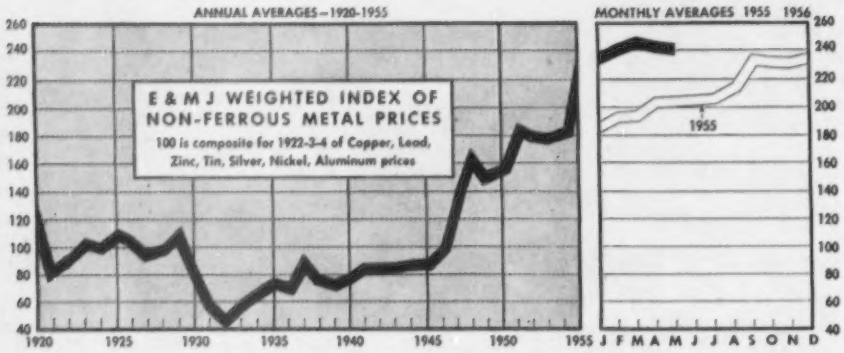
With American producers facing this kind of competition, and Louisiana's economy so heavily dependent upon sulphur, the contemplated tax increase seems hard to justify. The increased revenue will not be nearly so important to Louisiana as would be convincing evidence that Louisiana wishes to offer a favorable climate for venture capital and industrialization.

Just because a state happens to be endowed by Nature with rich deposits of a major mineral does not give that state a right to extort high levies which consumers in the rest of the states will eventually have to pay. What would happen to the U.S. if Minnesota with its iron, and Arizona with its copper, and the Plateau states with their uranium resorted to economic hijacking with unreasonable severance taxes? We'd end up with an economic war between the states.

The plain facts are that the strength of the United States rests upon the resources and industrial production which the states share with each other, and employ in the mutual defense of the nation in time of crisis. It is equally important that this relationship be maintained in time of peace.

E&MJ OUTLOOK

PRICES


ANNUAL AVERAGES—1920-1955
E & M J WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is composite for 1922-3-4 of Copper, Lead, Zinc, Tin, Silver, Nickel, Aluminum prices
MONTHLY AVERAGES 1955 1956
1955
J F M A M J J A S O N D

MARKETS

E&MJ's metal price index continued its decline during May, dropping 2.15 points from the April level of 246.50 to 244.35 for May. The weakening copper market abroad accounted for most of the drop.

AT HOME

Domestic uranium ore production will probably total 1.5-million tons for 1956. Production could eventually go to about 2.5-million tons.

As a fertile fuel material, thorium is definitely in the atomic research and development picture, but there's no urgency to acquire it at present because military uses require uranium.

Looming on the horizon is nuclear power for ore boats. Lower fuel costs and bigger pay loads are the attractive goals.

Future stress in heavy equipment design will turn to operator comfort and ease of maintenance and part replacement.

Are we losing a vital race with Russia by not training enough engineers? Read the McGraw-Hill editorial pp 119 and 120.

Chief Consolidated Mining Co. and other interests in Utah's Tintic district are negotiating with Bear Creek Mining Co. to establish a unit lease agreement which will bolster exploration and development in the area.

Colorado's uranium production last year was valued at $121-million, according to Walter E. Scott Jr., commissioner of mines.

LABOR

Mine-Mill's publication, "The Union," says *E&MJ*'s labor reporting is full of "half truths, distortions and outright fantasy." Among other things, they object to our prediction that the 20c pay boost demands plus fringe demands will be in the 30c range. They say it will not be that much. Next month's news will tell.

ABROAD

Bolivia is making a concerted effort to straighten out its mining industry. British and American mining consultants are advising the government. President Estenssoro told miners recently that Bolivia's inflation stems from poor discipline in the nationalized tin mines.

Russia's annual aluminum production is reported to be about 500,000 metric tons. Total for the satellite countries is about 70,000 metric tons.

Atlas Consolidated in the Philippines produced 4,664 tons of concentrates in April containing 21.4% copper and 0.13 oz gold per ton.

Minerals Engineering Co. of Grand Junction, Colo., is now opening up tungsten properties in Sonora, Mexico, to supply tungsten to Darby & Co., London, England. Other production will go to the U. S.

More than 30 nations have asserted their exclusive rights to minerals on adjacent sea floors during the past 10 years. Italy now plans to do likewise.

Active sulphur exploration in Colombia may soon extend the Gulf Coast belt of sulphur domes and introduce more competition in the industry.

London Copper Prices Fall to 36.4c
U. S. Custom Smelters Sell at 40c

MAY ECONOMIC ACTIVITY continued at a high level but there were suggestions it might not be as high as April and preceding months. The Federal Reserve Board's index for May will probably be about 140% of the 1947-49 average; April was 142 and the all time high was 144 in December 1955. Further declines in auto output, at a time of year when production is usually rising, drops in steel output and some lowering in various metal products is expected to affect the index.

Non-ferrous metal prices in May dropped to 244.35 from 246.54% of the 1922-24 average. The decline was mainly a result of the fall in the copper average from 46.161c to 45.531c in May. The drop in tin by more than 2c also had some effect.

Copper prices continued to fall in May. During the first half of the month London prices varied from £337½ prompt bid to £354½. In the latter half of the month they continued their unsteady drop and on May 31 reached £293, about 36½c. This is a drop of about 18c since London reached its high on March 19.

Dealers in the U. S. are hesitant to bring in copper from Europe; the margin between the U. S. custom smelters' prices and the effective price of copper in Europe after allowance for freight and insurance and handling charges makes a profit uncertain.

Custom smelters here reduced their price to less than the producers' price of 46c lb delivered, at the beginning of May—it may have been available on the last day of April. It dropped during the course of the month—until late in May it was 45c, some was sold at 44½c and then the price dropped to 43c. By May 28, metal could be bought for 40c.

Rhodesian Selection Trust companies, Roan Antelope, Mufulira and Chibuluma reduced the price at which they sell electrolytic copper to U. K. consumers to £320 per long ton, about 40c lb. The previous drop, to £350, had occurred effective April 30. Prain, chairman of the companies, continued to talk of the reasonableness of a price in the range of 30c-35c. With London persistently lower than 40c by 3c or more, many observers believe RST may come down again. However, the RST price is for electrolytic; including the premium (on wire bars) over the LME price the differential is only about 2c. For a considerable period RST was selling at much less than the LME price.

U. S. producers held to the 46c delivered price. With other sellers underselling them by as much as 6c here and more abroad, one wonders how long they will continue to price their copper at 46c. Most of their copper is priced on the date of shipment—the buyer normally buys for delivery the following month, the price to be set by the seller on the date he ships the copper. In the past two months with falling copper prices some buyers (apparently) felt that by the time copper was shipped to them, the producer price would have dropped. Many factors had in mind the continual statements by producers that 46c was too high. Now they wonder if the producers have decided to go into the labor negotiations with the 46c price.

Copper and brass fabricator activity is clearly down. There are reports that some of them are working a four day week. Some have laid off workers. In part this situation reflects the slump in the auto industry, but other industries are also involved. U. S. Copper Association statistics in 1956 for the copper and brass fabricating industries follow:

	Jan.	Feb.	Mar.	Apr.
Sales	151,278	107,295	144,897	93,613
Shipments	138,600	130,923	135,746	118,839
Stocks ..	376,753	388,823	392,143	413,979
Unfilled orders .	305,942	282,314	291,465	266,239

The sales and shipment series are related only to purchases of refined copper by the fabricators, including copper refined by custom smelters from their intake of scrap. All series are for fabricated products except stocks which refer to refined copper.

Kennecott, early in the month announced that Braden copper in the future would be priced when it arrives here from Chile and that the price would be the same as that charged for its domestically mined copper.

Prices of most brass ingots dropped about 5c during the month. Custom smelters' No. 2 copper scrap buying price, which had been about 39c late in April, went as low as 30c the last of May.

ODM announced early in the month that GSA was to arrange delivery of copper destined for the stockpile. The schedule is 7,600 tons for the 3rd quarter of 1956; 11,200 for the 4th; 9,800 for the first of 1957; 6,200 for the 2nd; 2,300 for the 3rd; 1,900 for the 4th.

Copper Institute data for March and April follow:

United States

Production:	Mar.	April
Crude, primary	(a) 99,681	95,400
Crude, secondary	12,595	13,585
Totals	(a)112,276	108,985
Refined copper	144,027	140,032
Deliveries, refined	141,590	139,927
Stock at end, ref'd.	51,595	54,887

Outside United States

Production:		
Crude, primary	(a)145,995	138,177
Crude, secondary	1,697	936
Totals	(a)145,692	139,113
Refined copper	(a)114,435	114,430
Deliveries, refined	(a)120,224	102,317
Stock at end, ref'd.	(a)174,232	183,238

(a) Corrected figures.

The chairman of the RST copper companies said they were considering expanding operations at Mufulira and also opening another mine.

Lead remained at 16c New York throughout May. Sales were lower than in previous months and most sellers were not optimistic. They felt there was no immediate prospect of a price decline owing to the Government buying program. Lead data released by the American Bureau of Metal Statistics show stocks held by producers at the end of April at 53,958 short tons; at the end of March they were 52,089 tons. Output in April was 52,976 tons and shipments to consumers were 44,986; exports were 644 and shipments to the Government were about 5,477 tons. London lead, prompt bid, reached a low of £109½ on the last day of May; forward was £106½. These prices are the equivalent of about 13.7c and 13.3c.

The U. S. Government announced it might take lead and zinc in its barter program. The barter arrangements involve trading Government agricultural products for materials abroad. The barter arrangements do not need to be two-way trades so the country where the metal originates need not receive the agricultural products. Many factors feel such a program would contribute to maintaining the lead and zinc price since it would reduce the probablity of sales here at lower prices.

Zinc sales in the U. S. have not been good but owing to the Government buying program the price is expected to hold at 13½c East St. Louis. London prices dropped about £5 during the month. Now prompt is a little under 11½c a lb. The New Jersey Zinc strike, which began May 1, has not been settled.

A summary of the March and April 1956 statistics of the American Zinc Institute, in short tons, follows:

	Mar.	April
Stock at beginning	39,833	40,038
Production	91,690	88,664
Production, daily rate	2,958	2,955
Shipments:		
Domestic	84,204	74,788
Export & drawback	460	1,437
Government acc't.	6,821	4,570
Totals	91,485	80,795
Stock at end	40,038	47,907
Unfilled orders	53,078	46,106

Quicksilver prices declined during the month. Little business was being done.

Aluminum prices charged by secondary producers declined during the month. They are now below the prices charged by primary producers for comparable grades. Many observers say this is the normal situation. The weakening in aluminum is partly a matter of the general weakening in the economy but it also reflects increasing output of the metal. Primary output in April reached a new high of 4,824 short tons per day; March was about 4,706 tons. Total primary in April was 144,726 tons. ODM announced the U. S. Government would take no aluminum the last half of 1956.

MARKETS *(Continued)*

Average Prices May (E&MJ Quotations)

Copper:	
Electrolytic, domestic refinery	45.531
Electrolytic, export refinery	43.118
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and Sterling exchange:	
Silver, New York, per oz.	90.750
Silver, London, pence per oz.	78.892
Sterling Exchange, "Checks"	280.758
Zinc:	
Prime, Western, East St. Louis	13.500
Prime, Western, delivered (g)	14.000
Tin:	
New York Straits	97.038
New York, 99% min. (e)	96.038
Gold, per oz. U. S. price	$35.000
Quicksilver, per flask	265.231
Antimony (*E&MJ*) (d)	36.470
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$104.154
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	25.900
Magnesium, ingot (h)	33.750
Nickel (f)	64.500

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Cadmium average based on the producers' quotations.
(b) Cadmium average based on the average of the producers' and platers' quotation.
(c) Cadmium average based on platers' quotation.
(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(e) Tin content.
(f) F.o.b. Port Colborne, U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) Correction, April should be 33.150c.

"Free" Gold Market

International trade volume declined 15% in may. The rise of the dollar led to a decline in the price of bar gold in Rio and in Istanbul. Coin prices rose in European, South American and African markets in active trading. Soviet gold sales of about four tons were reported.

	COINS		BARS (12.5 kg)	
	Apr. 30	May 31	Apr. 30	May 31
NEW YORK, transit	.....	.....	$35.08	$35.08
MANILA	$42.00	$43.00	36.10	36.15
HONG KONG	44.15	43.00	38.05	38.05
BOMBAY	57.15	55.50	56.30	54.00
TANGIER	41.50	42.15	34.90	34.92
BEYROUTH	42.45	42.75	35.12	35.12
PARIS	42.50	43.20	35.75	35.60
BUENOS AIRES	40.00	40.85	35.95	35.50

Note: Prices are computed at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

May 1956	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	45.700	44.475	16.000	15.800	14.000	13.500	24.000	97.750
2	45.475	43.900	16.000	15.800	14.000	13.500	24.000	97.875
3	45.500	43.675	16.000	15.800	14.000	13.500	24.000	97.875
4	45.525	43.375	16.000	15.800	14.000	13.500	24.000	97.500
5	No Market	43.375	16.000	15.800	14.000	13.500	24.000	97.500
7	45.400	43.875	16.000	15.800	14.000	13.500	24.000	98.000
8	45.425	43.675	16.000	15.800	14.000	13.500	24.000	97.500
9	45.475	43.775	16.000	15.800	14.000	13.500	24.000	98.250
10	45.550	43.925	16.000	15.800	14.000	13.500	24.000	97.375
11	45.625	43.450	16.000	15.800	14.000	13.500	24.000	97.125
12	No Market	43.450	16.000	15.800	14.000	13.500	24.000	97.125
14	45.600	44.325	16.000	15.800	14.000	13.500	24.000	97.125
15	45.650	44.200	16.000	15.800	14.000	13.500	24.000	97.125
16	45.650	43.625	16.000	15.800	14.000	13.500	24.000	97.750
17	45.625	43.925	16.000	15.800	14.000	13.500	24.000	97.375
18	45.575	43.000	16.000	15.800	14.000	13.500	24.000	97.000
19	No Market	43.000	16.000	15.800	14.000	13.500	24.000	97.000
21	45.650	45.450	16.000	15.800	14.000	13.500	24.000	97.000
22	45.650	44.150	16.000	15.800	14.000	13.500	24.000	96.875
23	45.450	43.975	16.000	15.800	14.000	13.500	24.000	97.500
24	45.400	42.275	16.000	15.800	14.000	13.500	24.000	96.625
25	45.500	40.400	16.000	15.800	14.000	13.500	24.000	96.625
26	No Market	40.400	16.000	15.800	14.000	13.500	24.000	96.625
28	45.650	40.275	16.000	15.800	14.000	13.500	24.000	95.875
29	45.400	42.175	16.000	15.800	14.000	13.500	24.000	94.500
30	Holiday	41.025	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
31	45.200	41.025	16.000	15.800	14.000	13.500	24.000	94.125
AVERAGES FOR MONTH								
May	45.531	43.118	16.000	15.800	14.000	13.500	24.000	97.038
AVERAGES FOR WEEK								
May								
2	45.655	45.042	16.000	15.800	14.000	13.500	24.000	98.458
9	45.465	43.625	16.000	15.800	14.000	13.500	24.000	97.771
16	45.615	43.829	16.000	15.800	14.000	13.500	24.000	97.271
23	45.590	43.917	16.000	15.800	14.000	13.500	24.000	97.125
30	45.488	41.092	16.000	15.800	14.000	13.500	24.000	96.050
CALENDAR WEEK AVERAGES								
May								
5	45.580	44.006	16.000	15.800	14.000	13.500	24.000	97.792
12	45.495	43.692	16.000	15.800	14.000	13.500	24.000	97.563
19	45.620	43.679	16.000	15.800	14.000	13.500	24.000	97.229
26	45.530	42.775	16.000	15.800	14.000	13.500	24.000	96.875

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

May 1956	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
1	90.750	78.875d.	280.7500	249s. 3d.	$35.00
2	90.750	78.875d.	280.7901	249s. 2½d.	35.00
3	90.750	78.875d.	280.8214	249s. 1½d.	35.00
4	90.750	78.875d.	280.9062	249s. 1½d.	35.00
5	(e)	(e)	(e)	(e)	35.00
7	90.750	78.875d.	280.9285	249s. 1d.	35.00
8	90.750	78.875d.	280.9062	249s. ¼d.	35.00
9	90.750	78.875d.	280.8883	249s. 1½d.	35.00
10	90.750	78.875d.	280.9062	249s. 1¼d.	35.00
11	90.750	79.000d.	280.7857	249s. 1¼d.	35.00
12	(e)	(e)	(e)	(e)	35.00
14	90.750	79.000d.	280.7812	249s. 2½d.	35.00
15	90.750	79.000d.	280.8660	249s. 2½d.	35.00
16	90.750	78.750d.	280.9553	249s. 1¼d.	35.00
17	90.750	78.750d.	280.9196	249s. ¾d.	35.00
18	90.750	78.750d.	280.7589	249s. 1½d.	35.00
19	(e)	(e)	(e)	(e)	35.00
21	90.750	Holiday	280.7991	Holiday	35.00
22	90.750	78.750d.	280.7723	249s. 2d.	35.00
23	90.750	78.750d.	280.6741	249s. 2½d.	35.00
24	90.750	78.875d.	280.5848	249s. 4d.	35.00
25	90.750	78.875d.	280.6250	249s. 3¾d.	35.00
26	(e)	(e)	(e)	(e)	35.00
28	90.750	79.125d.	280.5937	249s. 4d.	35.00
29	90.750	79.000d.	280.4010	249s. 4d.	35.00
30	Holiday	79.000d.	Holiday	249s. 6¼d.	Holiday
31	90.750	79.000d.	280.2589	249s. 8d.	35.00
AVERAGES FOR MONTH					
May	90.750	78.892d.	280.758	—	—
AVERAGES FOR WEEK					
May					
2	90.750	—	280.677	—	35.00
9	90.750	—	280.890	—	35.00
16	90.750	—	280.859	—	35.00
23	90.750	—	280.785	—	35.00
30					

Calendar Week Averages: New York Silver: May 5th, 90.750; 12th, 90.750; 19th, 90.750; 26th, 90.750.
(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash. New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations rae based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1953.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

London Metal Exchange Quotations

May	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1	337½	338	332	332½	111½	111¾	110¾	111	96¼	96¾	95¼	95½	750½	751½	747½	748½
2	345½	346	339½	340	112	112¼	111¼	111½	97	97¼	95¾	96	752	753	749½	750
3	346½	347	341	342	111½	111¾	111	111¼	96½	96¾	95¼	95½	755	757	752	754
4	340	341	333½	334	111	111¼	110¼	110½	96½	96¾	95	95¼	751½	752½	748½	749
7	338	338½	331½	332	110½	110¾	110	110¼	96	96¼	94½	94¾	750½	751	748	749
8	352	353	345	345½	110½	110¾	109½	109¾	95½	95¾	94¼	94½	752	753	750	751
9	349½	350	341	342	110½	110¾	109½	109¾	95½	95¾	94	94¼	754	755	752	753
10	350	351	343½	344	111¼	111½	109¾	110¼	95¾	96	93¾	94¼	752	754	751	752
11	354½	355½	346	347	111¼	111¾	109¾	110	95	95½	93½	93¾	752	753	751	752
14	351	352	341	342	110¾	111	109¾	110¼	94¼	94½	92½	92¾	750	752	751	752
15	343	344	332	332½	111¼	111½	110¼	110½	94	94½	92¼	92¾	746	748	748	750
16	341½	342½	332	333	111¼	111¾	110¼	110½	94¼	94½	92¼	92¾	752	753	752	753
17	341	341½	331	331½	111¾	112¼	110¼	110½	94¾	95¼	92¾	93	753	754	753	755
18	343	343½	334½	335	113¼	113½	111½	111¾	95¾	96	93¼	93¾	751½	752	752	752½
21	Holiday															
22	337½	338	330	331	113	113¼	111¼	111½	95¼	95½	92½	92¾	750	752	751	752
23	325	326	319½	320	111½	112	109¾	110¼	93½	93¾	91	91¼	755	756	754½	755½
24	313	314	309	309½	110¾	111	108¾	109	92¾	93	90¾	91	752	753	752	753
25	304	305	302	302½	111½	111¾	108½	108¾	93½	93¾	91¼	91½	747½	748	748	748½
28	309	309½	305½	306½	111¾	112¼	108¾	109	93¾	94	91	91¼	741½	742½	741½	742½
29	297	297½	295½	296	112	113	108¼	108½	92½	92¾	89¾	90	731½	732½	732	732½
30	301½	302	298½	299	112	112¼	108	108¼	93	93¼	90¼	90¾	730	731	730	731
31	293	293½	291½	292	109½	109¾	106½	106¾	91½	91¾	89¼	89½	725	726	725	726
Av'g's	£332.773		£326.466		£111.545		£109.847		£94.818		£92.881		£748.511		£747.761	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted.

MISCELLANEOUS METALS

May 31, 1956

Aluminum ingot, 99 plus % lb			25.9¢
Antimony, spot, lb, less than carload, in cases			36.47¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb			$2.25
Cadmium, commercial sticks, delivered, lb			$1.70
Calcium, lb, ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb, contract			$1.25
Cobalt, 97 to 99%, per lb			$2.60
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz			$2.25
Lithium, lb, 98%	$11.00	@	$14.00
Nickel, cathodes, lb, f.o.b. Port Colborne (a)			64¾¢
Magnesium, 99.8%, carloads, lb, producer's plants, Freeport, Texas, Eff. Apr. 16			33¾¢
Palladium, troy oz	$23.00	@	$24.00
Platinum (wholesale lots) troy oz	$103	@	$110
Quicksilver, flask of 76 lb, 25 flasks or more	$263	@	$265
Selenium, 99 plus %, lb. (Feb. 1)			$13.50
Silicon, minimum 97%, carloads, lb			20½¢
Tellurium, lb	$1.50	@	$1.75
Thallium, 100 lb or more, lb			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb			(b)$3.25

(a) Includes U. S. duty. (b) Effective May 14, 1956. (c) March 29, 25.765¢, corrected.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$37.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$23.50	@	$24.50
48% Cr_2O_3 3 to 1 ratio	$44.00	@	$54.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.25
Mesabi bessemer			$11.00
Mesabi, non-bessemer			$10.85
Lead (Galena), 80%, Joplin, Mo., ton			$201.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties $1.27 @ $1.30 c.i.f. U. S. ports, duty extra, nominal. Long-term contract nominal.			
Molybdenum Ore, 90%, per lb of Mo f.o.b. mines	$1.10	@	$1.15
Columbium-Tantalum, per lb, combined oxides	$1.15	@	$1.35
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$33.00	@	$33.50
Domestic, scheelite, 60% f.o.b. mill			$63.00
Vanadium Ore, per lb of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal. (b) Corrected.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb, in bbl carload lots delivered			5¼¢
Cobalt Oxide, 72½% to 73½%, ceramic grade, per lb	$1.96	@	$1.98½
Copper Sulphate, 100 lb			$16.70
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.30	@	[$1.33

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr. (4-9% C)			26½¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.			10.75¢
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained	$1.54	@	$1.66
Ferrosilicon, 50% per lb of Si f.o.b. shipping point			12¾¢
Ferrotungsten, 72 to 82%, lb of W contained (eff. Feb. 1)			$3.45
Ferrovanadium, per lb of V delivered	$3.10	@	$3.30
Silicomanganese, max. 1½% carbon, lb, contracts			12¢
Spiegeleisen, per long ton, 19 @ 21% grade			$94.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b. ,Vancouver, B. C. (U. S. funds) :			
Spinning fiber	$460	@	750
Shingle fiber, effective Jan. 1	$205	@	$300
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Bauxite, long ton, f.o.b. point of shipment:			
Domestic crude, 50 to 52% (not dried)	(a)$5.00	@	$5.50
Domestic, chemical, 55 to 58%	(a)$8.50	@	$9.05
Domestic, abrasive, 80 to 84%	(a)$18.00	@	$18.50
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$33	@	$35
60% effective CaF_2	$28	@	$30
Acid 97% concentrate, bulk, ton			c47.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.			
Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, prime, Texas, mines, long ton			$26.50
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$58.50
Steel f.o.b. Pittsburgh, billets, net ton			$68.50
Structural shapes, Pa., Ala. etc., 100 lb	$4.50	@	$4.60

AEC Extends Uranium Purchases

A NEW PROGRAM for procurement of uranium was announced Thursday, May 24 by the Atomic Energy Commission for the period from April 1, 1962 through December 31, 1966 and an extension of the present bonus program for initial production from Feb. 28, 1957 through March 31, 1960.

Announcement said, "The new domestic procurement program provides a guaranteed market for all uranium concentrates produced by domestic mills from domestic ores, subject to limitation, at the Commission's option, of 500 tons of U_3O_8 per year from any one mining property or mining operation and to compliance with Commission specifications. The price established is $8 per lb of U_3O_8 contained in normal mill concentrates or precipitates." (See *E&MJ*, May 1955 p 90)

Under the new procurement program, producers will be able to sell to licensed domestic commercial users in addition to the Commission.

In regard to the limit which the Commission, at its option, may put on the purchase of concentrates from any one mining operation, AEC says additional quantities above the 500-ton limit may be purchased, depending on requirements, but that such purchases may be at prices lower than $8.

Leaders in Western uranium mining industry showed general approval of the plan plus a few objections:

Charles A. Steen, president of Utex Exploration Co. and owner of majority control in Uranium Reduction Co.:

"So far as Uranium Reduction Co. is concerned, the program will mean more money to the uranium miner with higher grade ore than the miner now receives under Circular Five. Once our (Moab) plant is amortized, the concentrates from higher grade ores will give us more profit than we will be receiving under the present schedule and mill contract. The new schedule is going to hurt the miner of marginal ore and the marginal mill operation. In this latter category, I would include the mills which were built early in the program to handle both vanadium and uranium and which got high prices for their concentrates."

Mr. Steen said the Mi Vida mine in Big Indian district would be "pretty thin" so far as ore reserves were concerned by end of present program March 31, 1962. He estimated that there would be a "few hundred thousand tons of ore" left by that date.

Thus, he said, Utex, the mine owner, would not be affected by the 500-ton limitation. Such limitation is estimated in these parts to be equal to about 200,000 tons annually, based on average 0.25% U_3O_8 ore.

"The Commission is making an excellent initial step. At least we now have a floor under things," Mr. Steen continued. "If they (the AEC) want more production after March 31, 1962 than provided for in the new schedule, all they have to do is to amend the price—just as was done in the past with Circular Five."

As for the initial production bonus extension, Mr. Steen said "that can be pretty important to the prospector. I know it was to me in getting into production." He does not believe, however, that this extension will have any great or immediate incentive to exploration.

He does believe, firmly, however, that the "new schedule, extending as it does Government purchases, will speed up exploration by integrated companies." His is such an operation.

D. W. Viles, vice president at Durango, Colo., of Vanadium Corporation of America:

"I feel the new schedule will encourage developments generally in the industry. Naturally, it will encourage the operators of the new plants (mills). It is my understanding that we will have a fixed price for concentrates which will let anyone produce in competition. That will be best for the taxpayer. Elimination of the vanadium program will work hardships on the combination (uranium-vanadium) mills. We will continue to buy vanadium. As a metal and alloy it has both a great present and a great future. The price for vanadium," Mr. Viles estimated, "won't be much below the present government purchase price (31c a pound). It might be above that by 1962," he said.

"The Commission, I am sure, has given this new program a lot of thought," Viles said. "We are confident we'll be in operation after 1962."

W. B. Hall, general manager in Salt Lake City of Vitro Uranium Co., a division of Vitro Corporation of America:

"The announcement certainly is encouraging in that it indicates, as we in the industry believe, that uranium is here to stay. But because of the economics involved, we cannot consider this program a bonanza to the American uranium miner.

"The Government is having quite a problem in trying to fix a price in 1962. We don't know what the price really should be then. General cost structures in the United States economy may be entirely different then, than at present," Mr. Hall said.

"Certainly we can say one thing: The profit on concentrates should vary on grade. There is very little incentive under the present program to buy high grade. With a flat, fixed price, for concentrates, grade of ore becomes a most important factor."

Mr. Hall estimated that there are "few uranium mills in the United States which could meet the $8 pound price for concentrates and make much money. Canadian mines and other foreign producers probably could."

He predicts more competition among mills for the higher grade ores. "The very large mills will be able to run with somewhat lower grade ore.

"You have to compare this situation with the copper industry today," he said. "The Bingham Pit of Kennecott Copper Corp. produces a low-cost copper. But other and smaller producers with higher costs are doing quite well at present.

"It is my opinion that the commercial, or civilian demand after 1962 will determine whether small mines and small mills can stay in business. The eight-dollar Government price will not keep them in business.

"Extension of the bonus will certainly help over a short term period the little prospector to continue to explore on properties that look favorable."

Marvin L. Kay, general manager, Climax Uranium Co., Grand Junction, Colo.

"It looks to me as if the program is designed to take care of the lowest cost operators and the high-cost boys are going to go. I believe the price of ore will go down after March 31, 1962. It'll be f.o.b. the mill, with haulage and recoveries a factor. The program is designed to take care of the big, lowest cost operators in the business, while at the same time maintain a semblance of an industry."

A. H. Shoemaker, general manager, Homestake Mining Co., Lead, S. D.:

"To a mill with accelerated amortization, there will be a market for sale of concentrates with a profit. This new program places the uranium business in the same category as lead, zinc and copper mining today.

"The extension of the initial bonus doesn't mean anything to responsible operators to whom it has been no sizeable factor anyway. It should be a big help to prospectors, though," Mr. Shoemaker said.

He estimated that Homestake's Utah division would have mined out all of its presently developed reserves in Big Indian District by end of present guaranteed program. The firm, which continues active in prospecting in Utah and Wyoming, probably will stay in the uranium business after 1962, however.

W. H. H. Cranmer, Salt Lake City, veteran miner and president of Lucky Mc Uranium Corp., which in cooperation with the big Utah Construction Co. is negotiating now with AEC for establishment of a mill in Gas Hills district of Fremont County, Wyo.:

"I like everything about the program except the apparent restriction on amount

of ore milled from one property in one year. They encourage a fellow to go ahead and build a mill. Then they arbitrarily put a limit on the amount of ore he can take from his own mine. How do they know now what conditions will exist in 1962 in a given district?

"The initial bonus is a misleading thing. It's based on the kind of ore deposition in the Uravan mineral belt—the small pocket stuff. It won't mean much to the industry as a whole but I suppose it will keep the little guy from hollering his head off.

"I'll say one thing for the fixed price on concentrates. It'll be good to get away from this idea in the industry that there's one kind of treatment for one fellow on a concentrates contract and another for someone else. That's good for everybody."

Robert R. Porter, Salt Lake City consulting metallurgist for Ute Milling, affiliate of Atlas Corp.:

"Everyone is very happy about the announcement, of course.

"The fixed price is something I've always argued for. The program is not everything that everyone would want.

"For example, it has built in features, such as the limitation on 500 tons from any one property, which goes counter to the entire history of the mining business—that is, the development of huge low grade properties which I feel certain we will find in the U. S.

"The program does place the mill exactly where it should be—near the mine. I can see that a lot of mills far away from their ore source are just not going to make it. Haulage costs so far as the miner is concerned, and the mill, too, will be a critical factor.

"The initial exploration bonus means little. There's been a decline already in interest by some small prospectors and the bonus program is in effect."

Mr. Porter repeated that "just as in the copper, gold, lead and zinc business, the big low grade deposits owned by major companies are the ones that produce the ore and make the profits. The Commission will some day have to recognize this in domestic uranium."

Tom Skidmore, past president of UOPA and John I. Schumacher, first vice president, who noted they were speaking as individuals and not for the association:

"The producers will be left at the mercy of the mills." The men noted that the $8 per lb concentrate price will permit large mills with adequate reserves to maintain their operations at a reasonable profit. They added "Small mills or those with high operating costs due to distance of source material or complex ore will be forced to close or pay the miner a lower price."

Uranium producers generally agreed that the bonus extension will give small operators a new lease on life. Some observers were frankly surprised at the extension, saying, "This is the last one we can hope for."

As we went to press . . . .

Appointment of former Senator Fred Seaton (R-Neb.) as new Secretary of Interior surprised many Washington "insiders." Observers see his liberal voting record in Congress as an Administration answer to "give-away" charges while noting that he acted as an able advocate for industry during the recent White House conference on minerals policy. (See Washington Impact, p 122.)

M. A. Hanna, Kaiser Aluminum and Reynolds Metals are reported by local sources to be eyeing the bauxite deposits recently announced in the Nuria highlands of southeast Venezuela. Alcoa, too, reportedly had technicians in the area recently. Nearby Caroni River hydroelectric project makes the huge deposit pretty attractive.

Opening of a new mine in the Copperbelt is planned at Chambishi, 20 miles west of Mufulira. Property was described by R. L. Prain, chairman of the Rhodesian Selection Trust companies, as being about the size of Chibuluma, which began shipping concentrates last month. (See p 102.) Capacity of the new Chibuluma concentrator has been placed at 40,000 tons ore per month. Total mill feed of all Copperbelt mines is 1.4-million tons per month.

Prain also announced that new ore reserves proved at the Mulfulira property, "one of the greatest underground mines in the world," are such that the company plans a 50% increase in production.

One ton of solid pitchblende, assaying a reported 80% uranium oxide was brought out of the United Uranium Co. mine at Elsharana, 150 miles southeast of Darwin, Australia.

36,000 tons of thorium oxide is reported in the plateau of Pocos de Caldas, State of Sao Paulo, Brazil. Government engineers researching a zirconium deposit in the area made the find.

Assistant Secretary of Interior Felix A. Wormser, speaking before the Senate Committee on Interior and Insular Affairs, recommended that special provisions be made by Congress to continue tungsten and asbestos for a limited period. Wormser proposed a purchase program of 1-million short ton units over a two-year period.

ODM director Arthur Flemming told the Senate committee during his testimony that he favored aid to the tungsten industry by continued purchases from non-defense funds until a long-term program can be considered.

Anaconda Co. named Clyde E. Weed, former vice president in charge of operations, to the office of president of the firm; Thomas A. Campbell, executive vice president of Chile Exploration Co. and Andes Copper Co. to vice president of Anaconda Co.; and Charles Brinkerhoff, former general manager of the South American companies, to succeed Mr. Campbell. Robert R. Dwyer, former president, and Earl O. Sowerwine, a vice president, are retiring.

Ground breaking ceremonies were held June 7 at American Brass Co.'s $25-million integrated aluminum plant at Terre Haute, Ind. John A. Coe is president of the Anaconda subsidiary. Production target for the new facility has been set at late 1957.

Behind the By-Lines...

G. P. Lutjen

Every year about this time we are afflicted with what our ten year old son claims is clearly stratoneurosis. Very prevalent in outer space, he says. The fact is however, that other than registering for an early trip to the moon, we have had very little to do with outer space in recent years.

Our symptoms (violent arguments with the typewriter, a real headstrong machine, and a strong addiction to paper airplanes) stem more from months of relentless pressure involved in producing the annual *E&MJ* Mining Guidebook and Buyers' Directory issue. This year's effort, a 128-page panorama of equipment and methods available to solve technical problems in exploration, open pit and underground mining, ore dressing and metallurgy, kept the whole staff chained to the oars, as it were, for several months just doing necessary research, but is now in final stages of production. We regard the entire project as a many-splendored thing although we are ready to face the fact that the word "useful" will probably be used a lot more than "magnificent" or "breath-taking" in referring to the 1956 Guidebook. If it's not in your hands in two weeks, heads will roll.

For practical men only is the 10-page story on titanium production starting at page 78. Written by Mike Mastin, a practical man with years of experience in titanium both with the USBM plant at Henderson and as a consultant, it is a look at the practical techniques employed by titanium producers plus some ideas on what might be done. In the present stage of titanium economics (or is it politics?) this type of story means treading on touchy ground. Mr. Mastin has trod extremely well. His revelations go to the point where one more word would be a violation of a company confidence.

Important contributions were made to the article by the Bureau of Mines and several producers who furnished photographs detailing the high spots of their production practices. Indicative of how cagey some producers are playing their cards in the titanium game, was the contribution of one company that sent us some excellent literature but the photographs were those contributed to a special *E&MJ* issue published in 1949! Nevertheless, we are grateful to all those companies and to the Bureau for their help.

Last month's essay on television didn't pass unnoticed. One of the clients wrote in saying that he momentarily expects to tune in his favorite TV program and hear; "Now, Mr. Smith, you have picked mining for your category. For $64,000, will you please explain the following terms used in the mining industry—1. Cherry Picker 2. Glory Be 3. Roof Sewing 4. Gismo 5. Jumbo 6. Widow Maker 7. Grizzly 8. Whaxle 9. Chippy Doctor 10. Whup d'Whup."

Think you'd make $64,000 on that?

The only one that might give an old mining man any trouble would be the Whup d' Whup. This is a brand new item that solves one of mining's tough problems. John S. Wright, mine manager for San Francisco Chemical Co. at Montpelier, Idaho, and Roger Pierce, Salt Lake City consultant, tell you all about the Whup d' Whup starting on page 88.

Highlights of the business sessions of the lead-zinc meetings held in St. Louis toward the end of May, are reported on page 100. We're sorry that we can't furnish any coverage of the social side of the meeting unless we pass along the report of a friend who returned to New York with eyes completely and beautifully bloodshot. He laid his whole condition to Bourbonic Plague.

This month's special is a large selection of Ways. We've got sixteen to protect trolley locomotive operations and five to refine volcanic sulphur; a total of 21 assorted Ways.

You'll find the 16 on locomotives on page 75. Chances are even old locomotive men will find some new slants there. "Five Ways to Refine Volcanic Sulphur" on page 96 is as much a challenge to the reader as it is a report. In Chile they might give you the ball if they thought you could run with it.

Our man in charge of the More-Effective-Signs-for-Plant-and-Office drive, has just come up with two more candidates.

FLATTERY WILL GET YOU SOMEWHERE—START TALKING

ACCURACY IS OUR WATCHWORD—WE NEVER MAKE MISTEAKS

Speaking of misteaks, our May issue had a masterpiece. In the lead story on germanium, we somehow managed to misplace Tsumeb by three or four thousand miles. With a flick of the typewriter, we gave the French one more thing to think about in Morocco.

This was not done out of sheer whimsy as one correspondent intimated. Nor is there any truth in the rumor that we figured Africa was so big nobody would notice.

Despite the manhandling of one of the continent's important mining properties, we have been gratified by the number of people requesting reprints of the germanium article. In the reprints, now available at 50c per copy (Please address Reprint Editor), and we are happy to report that Tsumeb has been returned from whence it came. Now if you'll excuse us, we'll tackle our next editorial assignment.

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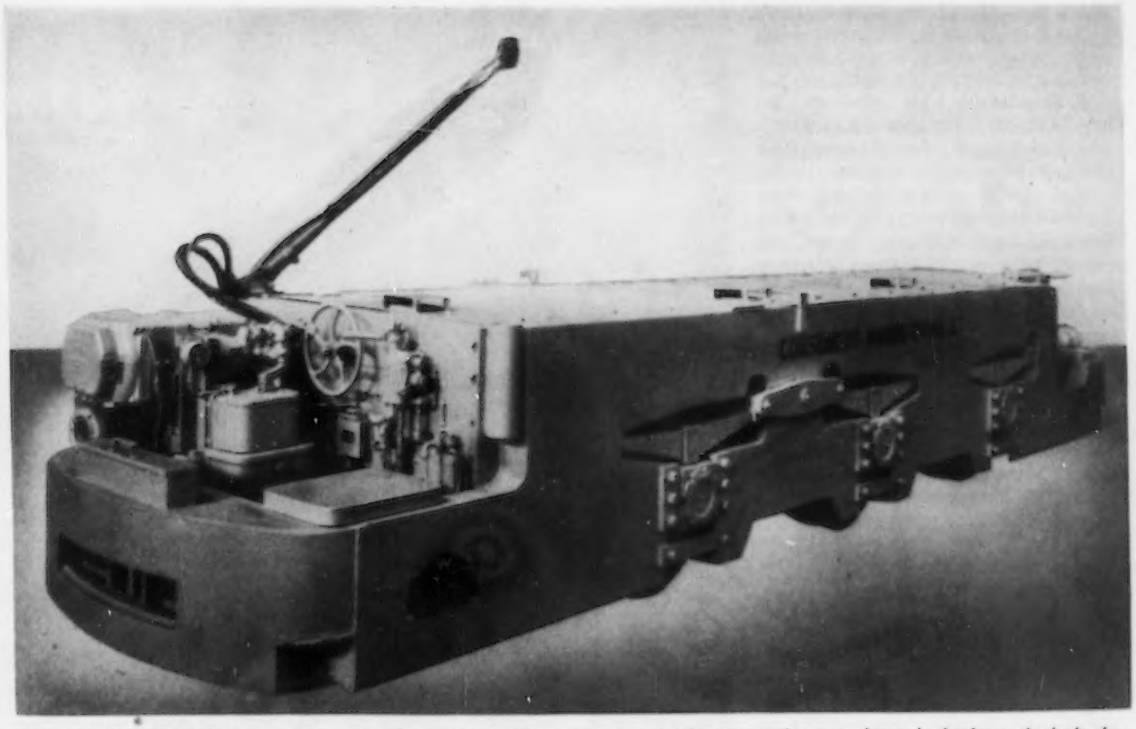


FIG. 1. THIRTY-TON 3-axle locomotive is equipped with electropneumatic storage battery, dynamic brake and air brakes.

Sixteen Ways to Protect Trolley Locomotive Operators

ALLEN McLANAHAN

IMPROVED MINING METHODS and mechanization (requiring heavier trains and greater speeds) have resulted in a steady increase in tonnage produced and distance to be hauled. The latest trend toward central processing plants has further increased the length of haul, necessitating higher operating speeds. Instead of a crooked track, of light rails on a rough floor, the modern track consists of heavy rails and ties laid on a well ballasted roadbed with a minimum of curves. Inbound and outbound tracks are in separate tunnels and automatic signals are used extensively. These changes resulted in a haulage system that is comparable with that of many railroads.

1. High-current protection. Early locomotives had very simple equipment consisting of a main fuse, controller and resistor. After a fuse failed, it was replaced with a piece of heavy wire, eliminating any protection. This required the controller to open currents beyond its capacity, resulting in damage to equipment. However, the danger was lessened by the use of a magnetic contactor, mounted away from the controller, which opened the circuit on shut off. In connection with an overload relay, this line switch also took care of any high currents which might result from grounds or other faults.

2. Low load currents in the controller. As the size of motors increased, larger controllers were needed for higher currents, involving the problem of handling these currents on a drum with sliding fingers. This was overcome by substitution of magnetic contactors in all power circuits where current was broken. Since only small control currents were opened in the controller, chance of injury to the operator was greatly reduced. Application of remotely controlled power-operated reversers finally eliminated all load currents from the controller.

3. Quick-operating lever brakes. Brakes of the early locomotives were operated by hand through a screw and nut. Because of restricted space, diameter of the operating wheel was small. Considerable effort, usually with both hands, was required to apply the brakes. The lever-type brake was an improvement over the screw brake. Lever brakes have been arranged so that the operator can compensate for brake shoe wear without leaving the cab, making available full braking power at all times.

4. Effortless power braking. With heavier trains and locomotives, power brakes (operated by either air or hydraulic pressure) came into use. Since the brake valve can be controlled by one hand, without change of position, little physical effort is required of the motorman and there is less distraction from the operation of the locomotive.

Mr. McLanahan is a member of the Westinghouse Electric Corp. staff at East Pittsburgh, Pa.

When power brakes are used, the hand brake is still available for emergencies and parking.

5. Dependable air pressure for brakes. Various features are used with power brakes for safer operation. Low pressure relays, with contacts in the control circuit, open this circuit when the reservoir pressure is below a predetermined point. Thus the locomotive cannot be operated unless pressure is high enough to stop it. Low air pressure alarms are also used to warn the operator if the pressure drops below a safe value. In certain cases, the emergency brakes are applied the moment power fails and cannot be released until power is again available. When locomotives are operated in tandem, the air brake system is arranged to apply emergency brakes in case the connection between the locomotives fails.

6. Shockless emergency brakes. Experience has shown that the shock from emergency brake applications may catch the operator off guard and possibly throw him out of the cab. In designing such braking systems care must be taken to control the rate of application so that excessive shocks are avoided.

7. Jump-start prevention after power failure. Contactors in the power circuit made it possible to provide more safety for the operator and for the equipment. When a locomotive with an ordinary drum controller lost power, the handle might have been left where it was, often in the full running position. When power was restored, heavy motor currents caused a corresponding jump of the locomotive. To prevent this a "no-voltage" relay was connected in the control for the line switches. When this relay opened due to a power failure, the circuits required that the controller handle be returned to "off" in order to reset the relay and permit the line switches to close, thereby applying power to the motors. The use of the "no-voltage" relay also provided low-voltage protection in cases where a number of locomotives tried to start at the same time pulling down the trolley voltage below safe limits.

8. No-operator-no-motion controls. A common cause of accidents was the practice of an operator leaving the controller notched up with the locomotive moving, running ahead for some purpose such as throwing a switch and then tripping and being run over. To prevent this and similar practices, the "deadman" control was adapted to this type of locomotive. This consists basically of a device connected in the control circuit which must be held closed by manual pressure. The most common

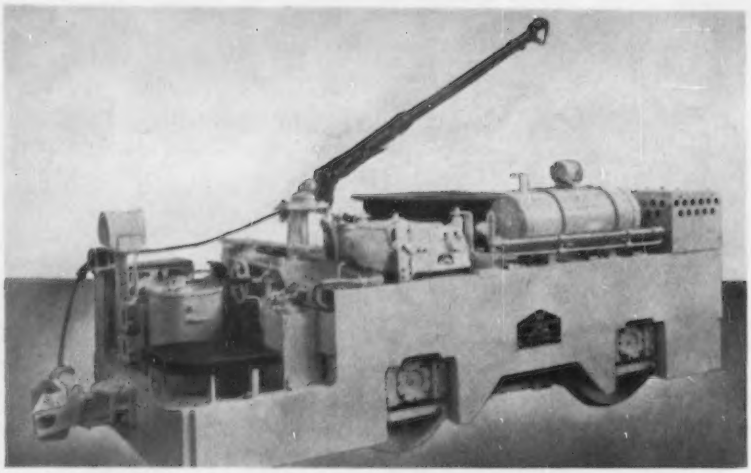


FIG. 2. SAFETY FEATURES include trolley retriever, time delay contactor for auxiliaries, low air pressure relay, and electropneumatic storage battery control.

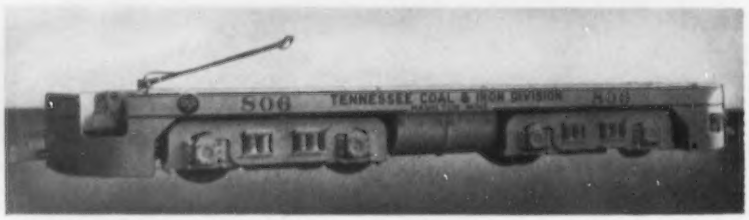


FIG. 3. DESIGN AND ARRANGEMENT of this locomotive assures greater operator safety. Note the rounded ends and protective plate for the operator.

arrangement consists of a main handle with a hinged section held up by a spring. During operation the handle is held down by the weight of the hand. When released, the handle flies up, opening the control circuit and cutting off power. The handle must be returned to "off" before it can again be pressed down. Operation of the handle may also open an air valve, applying emergency air brakes. Foot-operated push buttons are also used for the "deadman" protection. However, there is always the possibility of nullifying the protection by the use of a rock or similar object to hold the button down. Many companies now specify protection on their locomotives, requiring the operator to exert pressure on some type of contact device before the locomotive can be moved (Fig. 1).

9. Dynamic braking for lower brake-shoe wear. In many operations where grades are present, motors are used as generators to provide the necessary retardation when trains are descending grades. The use of dynamic brakes reduces wear on locomotive brake shoes and wheels and keeps the normal braking system (manual or power) always available to stop the train, if necessary. The dynamic brake is controlled by the operator to give the desired speed. Various additions have been made to the fundamental scheme to provide greater operating safety. In many instances the contactors which set up the braking circuit are normally closed by springs or air, and are held open by coils supplied from the line. In case of power failure, these switches close at once, establishing the dynamic brake. Since this provides only one value of brake, beyond the control of the operator, care must be taken to select a value which will provide sufficient braking without a severe shock. Since most heavy locomotives are now equipped with air brakes and electropneumatic control, the use of a storage battery to supply the control current provides a controlled dynamic brake in case of failure of line power. When a suitable control air reservoir is included, the dynamic brake can be used to control the speed until the train is off the grade, leaving the full air brake pressure available for an emergency stop.

10. Safe control for high speeds. Increased speed of modern locomotives has introduced problems to prevent or to control excessive speed. In one operation where excessive speeds were common in spite of overspeed relays, the union safety committee in-

FIG. 4. ANACONDA CO. has eighteen 10-ton locomotives equipped with contactor control, deadman system, dynamic brake and air brakes.

FIG. 5. KAISER STEEL CORP., at Sunnyside, Utah, has twelve 15-ton locomotives with electropneumatic control, dynamic and air brakes.

sisted that a positive system beyond control of the operator be installed. To accomplish this, the control was so arranged that operation of the overspeed relay set up automatic dynamic braking circuits which brought the locomotive to a stop. This circuit could only be reset for normal operation when the motorman got out of the cab and went to a push button located at the opposite end of the locomotive.

11. Automatic speed control at danger points. In another operation, loaded trains descended a heavy grade with a very sharp curve at the bottom. As a result of many accidents from excessive speed, an automatic speed control scheme was installed. When a locomotive approached the top of the grade, a trackside contact established an automatic dynamic braking circuit which maintained the predetermined speed down the grade. The operator could not reduce the amount of brake to increase the speed, but could at any time increase the brake to reduce the speed. When the bottom of the hill was reached, another trackside contact restored the control to normal.

12. Trolley-pole retriever. Trolley shoes or wheels will occasionally leave the wire in spite of improvements in track and overhead construction. Accidents have occurred, particularly during high speed operation, as a result of the pole breaking or pulling down the wire before the motorman could gain control. This danger has been reduced by the use of retrievers which automatically cause the pole to drop as soon as contact with the wire is lost (Fig. 2). This retriever consists of an air cylinder, mounted below the trolley base, with a piston which compresses the trolley spring when air is admitted to the cylinder. The air supply is controlled by a magnet valve, energized from the trolley, which admits air to the retriever when the pole loses contact with the wire. This not only provides fast action but allows the operator time to shut off the controller and apply brakes, if desired, before leaving his seat. A hand- or foot-operated valve is used to reset and allow the pole to go up again under control of the motorman. Additional apparatus may be used to control the rate at which the trolley goes up, and to permit the retriever momentarily to reduce the pole pressure when the motorman changes it from one wire to another.

13. Trolley flash prevention. When a pole is being placed in contact with the wire there may be flashing unless the wheel or shoe is properly seated the first time. The "no-voltage" relay has eliminated the possibility of power currents being broken. However, on modern locomotives the current taken by the auxiliaries (such as blowers, compressor and motor-generator) will cause a heavy flash when interrupted. The flash may not only blind the motorman, but might start an explosion under gassy conditions. This danger has been reduced by introducing a time delay in the closing of the auxiliary circuit contactor so the pole must be in definite contact with the wire before the auxiliary circuits are established.

While they are not actually a part of the control, a number of steps have been taken in the mechanical design and arrangement to provide greater safety for the operator (Fig. 3). Among these are:

14. Heavy steel guards around top of the bumpers.

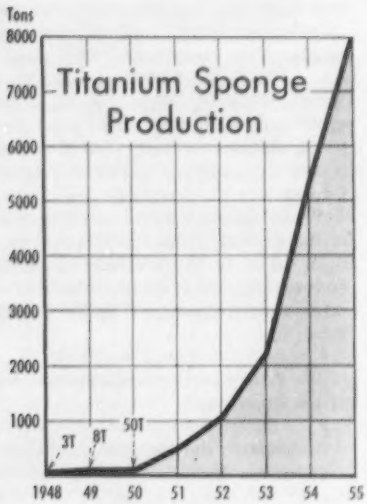
15. Seating the operator on the side opposite the trolley.

16. Automatic couplers to replace old link and pins.

Near Butte, Montana, two types of modern locomotives are in operation which incorporate many of the described safety features. The Anaconda Co. has eighteen 10-ton locomotives (Fig. 4) equipped with contactor control, deadman feature, dynamic brake and air brakes. The Kaiser Steel Co. at Sunnyside, Utah, has twelve 15-ton locomotives (Fig. 5) with electropneumatic control, supplied from a storage battery, dynamic brake and air brakes. These locomotives also have a heavy guard plate on the bumper to protect the motorman.

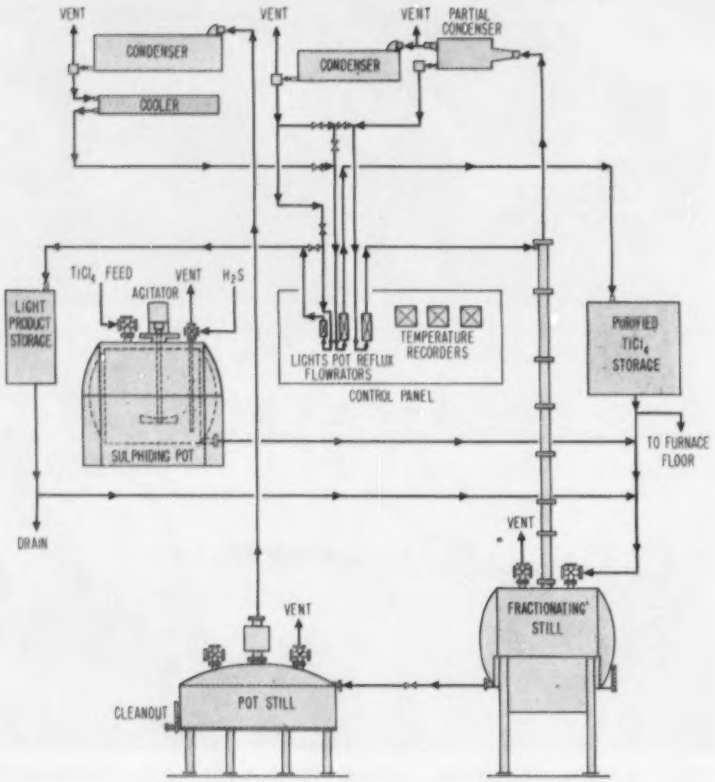
The modern electric locomotive for underground or industrial haulage is a much larger and more complex machine than the early ones. Because of the great restrictions in dimensions, the various pieces of equipment must be crowded into a small space and yet they must be accessible for maintenance. Since much more apparatus is now required, it has been possible to include the many safety features without making the control unduly complicated. As a result, many unsafe practices have been prevented, the danger from a flying trolley pole has been reduced and better methods of controlling speed or stopping a locomotive have been provided. Together they have resulted in a great reduction in the number of accidents and injury to men or equipment. In the long run this is "money in the bank" for the mine operator.

All drawings from U.S. Bureau of Mines Electrometallurgical Experimental Station, Boulder City, Nevada.



This Production Surge Is Spurring Efforts in . . .

FOR $TiCl_4$ PURIFICATION, THIS FLOWSHEET



Solving the Practical Problems of

M. G. MASTIN

IN THE PAST FIVE YEARS, many rumors of new and better processes plus a great deal of technical misinformation have harassed the titanium industry. True, there have been, are, and will be some knotty technical problems, but the progress made to date has been impressive and the knowledge gained, tremendous. It's time to take a good look at what we have learned about the practical problems of producing titanium and to straighten out some of the misinformation that may have found its way into publication.

Experimental work with the Kroll method of producing titanium began in earnest in 1941 and by the end of the decade, Du Pont with the aid of some know-how developed by the U.S. Bureau of Mines, erected a plant to make 2½ tons of sponge per day.

In 1950, Titanium Metals Corporation of America signed a contract with General Services Administration to construct facilities for producing 3,600 tons of titanium sponge per year.

In 1951, the USBM began the design of a ¾-tpd pilot plant sponsored by Army Ordnance. This plant began operation in July 1952 and ran until September 1954. It was a means of accumulating a great deal of information and it contributed its product and knowledge to industry.

Other companies have followed Du Pont into the titanium production field and extractive metallurgical processes are being evolved that should bring sponge costs, including plant amortization in five years, down to the order of $1.25 to $1.35 per pound even in a non-integrated plant. Even $1 sponge is in sight after amortization and with 10¢ $TiCl_4$.

Although most developments of private enterprise are guarded secrets because of the highly competitive nature of the titanium business, what has been learned, coupled with the extensive work of the USBM, gives us an insight into the practical production of titanium.

Mr. Mastin is a consultant with headquarters in Boulder City, Nev.

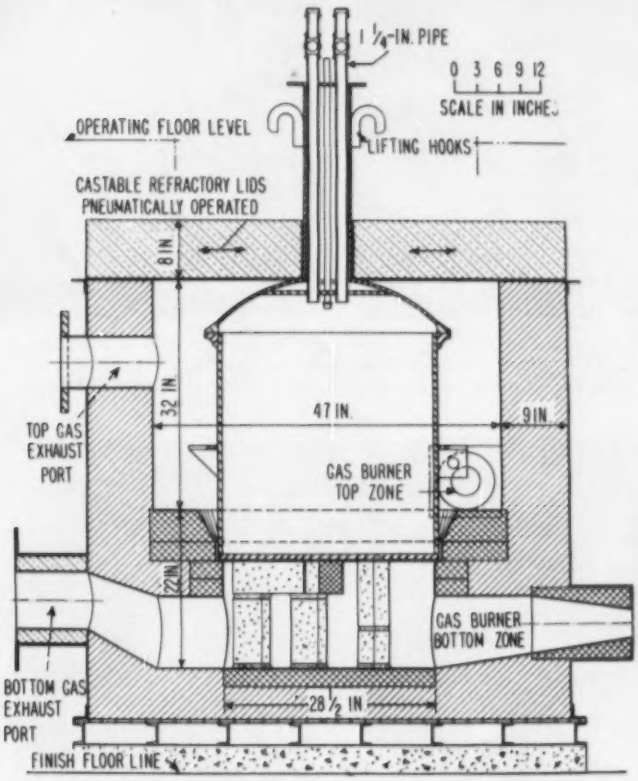
The Process

Producing titanium sponge using either Mg or Na is exceedingly simple in theory, but somewhat more complicated in practice.

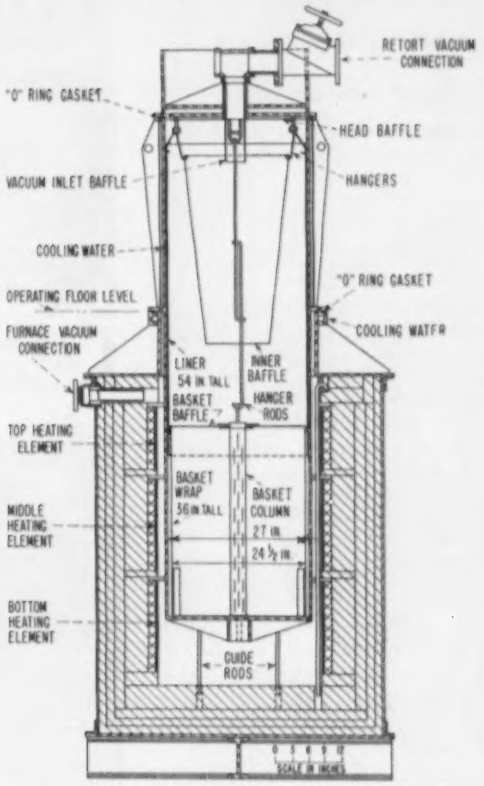
Clean Mg is placed in a steel vessel which is sealed, evacuated and filled with helium or argon to exclude air. After heating to raise the contents to about the melting point, pure $TiCl_4$ is admitted until all available Mg is used up. The vessel is cooled, opened out of contact with moisture, and the contents are removed and separated into pure Ti and $MgCl_2$ (plus some excess Mg) by distilling off the latter in a high vacuum, or by acid leaching. Purified metal is crushed to size and packed in tight containers.

Essentials of the process may be summed up by saying: "Reduce the best possible $TiCl_4$ with absolutely clean Mg and purify the product in such a way that oxygen, nitrogen and carbon are rigidly excluded from contact with heated Ti." Adherence to this program will certainly yield metal not harder than 100 BHN.

FOR SPONGE PRODUCTION, THIS REDUCTION POT



FOR PURIFICATION, THIS RETORT



Titanium Production

Preparation of $TiCl_4$

The sole commercial feed used today for production of titanium sponge is $TiCl_4$, although small amounts of very pure, crystalline Ti are being made from the tetraiodide.

$TiCl_4$ is a colorless liquid with a density of about 1.72 which throws out dense white fumes containing HCl when exposed to moist air. When handled in a system without leaks it does not become acid, and does not corrode iron, steel or any of the usual metals. It attacks rubber, neoprene and most other plastics, but teflon gaskets are satisfactory.

$TiCl_4$ may be made by the chlorination of nearly any titanium-bearing raw material. Usual raw materials, in the order of their importance, are:

Rutile, the dioxide, is derived primarily from Australian beach sands, although it is found elsewhere including Florida and Mexico. Market grades commonly contain 95% TiO_2 or better. Mixed with carbon, it chlorinates readily at 800 deg C. It costs from 6 to 7c per pound delivered in this country at the present.

Sorel slag is an electric furnace product of the arc-furnace reduction of ilmenite at Sorel, Quebec. Pig iron is the by-product. Ilmenite is an iron titanate usually containing an excess of iron oxide. The slag contains about 74% TiO_2 plus notable amounts of the oxides of iron, aluminum, calcium, magnesium and silicon. It chlorinates readily at the same temperature as rutile, but the impurities partially chlorinate also, thus giving lowered chlorine efficiency. Some of the chlorinated impurities distill over with the $TiCl_4$, complicating the condensing system. Sorel slag sells for nearly 2c per pound at the point of origin.

Ilmenite contains widely varying amounts of TiO_2, although 20 to 25% may be used as an average figure. It also chlorinates readily, but much chlorine is consumed by the iron and other impurities, and will not likely be an interesting raw material until someone finds an economic way of recovering chlorine from iron chloride.

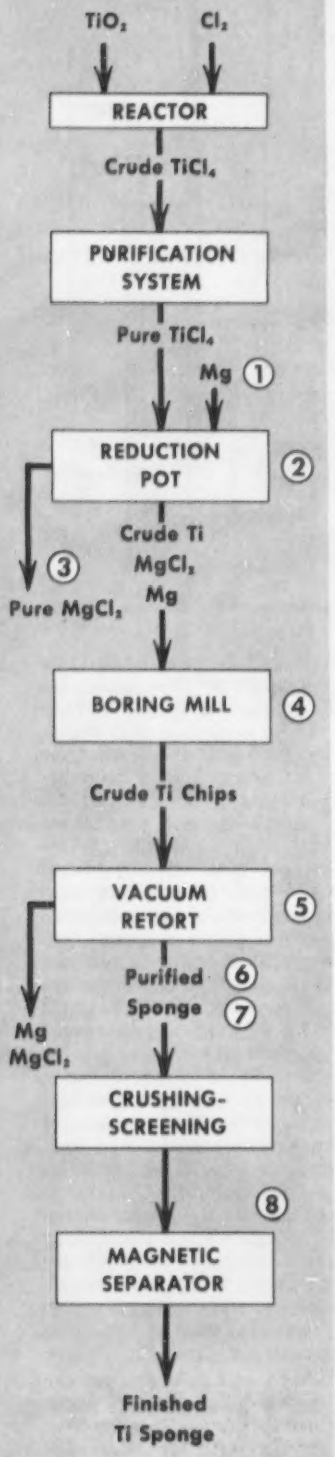
Titanium carbo-nitride is an electric furnace product. It contains nearly the same percentage of Ti as rutile, but costs about 50c per pound. It chlorinates readily at around 200 deg C, giving off much heat of reaction (contrary to rutile) and leaving little ash. If it were not for its high cost, this product might be the most satisfactory.

The chlorinator is usually a cylindrical column lined with acid-proof brick with means for providing heat not furnished by the reaction, followed by a condensing and collecting system. Or the chlorinator may be Fluo-Solids apparatus. With the first three raw materials named, carbon is added to the feed to combine with the oxygen of the TiO_2 and sometimes to provide added heat obtained by the admission of controlled amounts of air. Means must be provided for the removal of ash, although this is not so important when chlorinating rutile because of its low content of impurities.

Crude $TiCl_4$, as it appears on the market, contains many impurities. Some which have been identified are a hydrated oxide of titanium caused by exposure to moist air, phosgene, $SiCl_4$, a complex silicone boiling at the same temperature as $TiCl_4$, HCl, Cl_2, CO_2, $VOCl_3$, $FeCl_3$, and mono-, di- and trichloroacetyl chlorides. Other compounds are known to be present at times. If H_2S has been used to re-

KROLL PROCESS FOR TITANIUM

(Circled numbers refer to photographs at right)



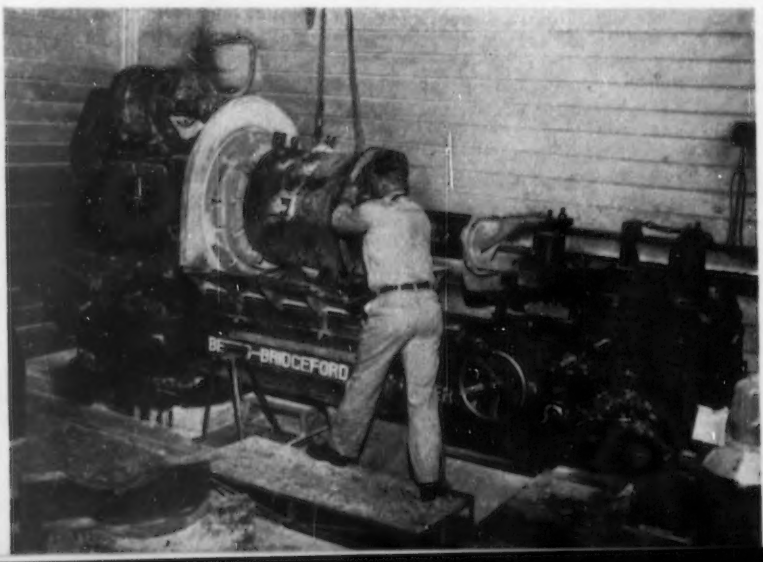
1 **Magnesium** is charged to reduction pot as solid metal. $TiCl_4$ from chlorination of ore is piped in as liquid when Mg has melted.

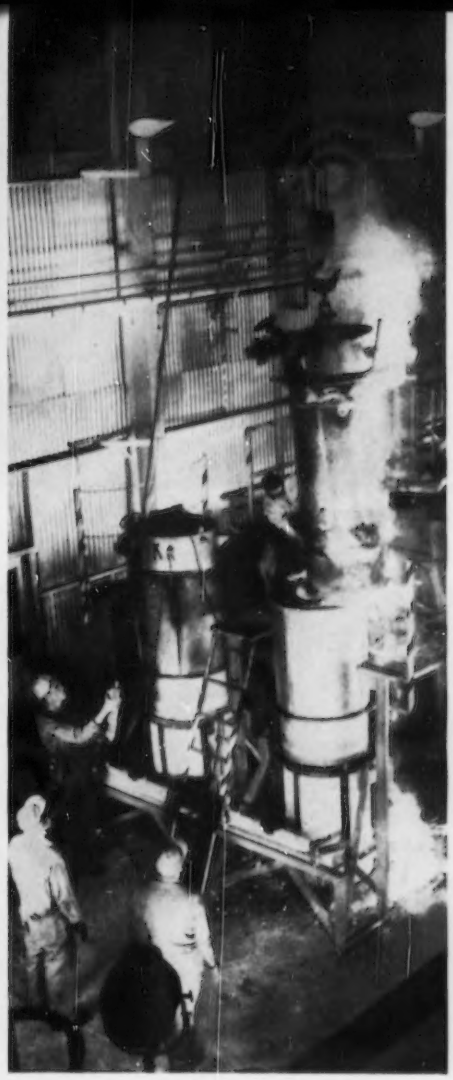
2 **Sealing the pot** is important as the $TiCl_4$-Mg reaction is carried out in an inert atmosphere.

3 **Tapping removes** most $MgCl_2$ formed by reaction of $TiCl_4$ and Mg. Titanium sponge produced contains more $MgCl_2$ plus Mg which must be removed later.

USBM develops processing

4 **For boring** our crude titanium sponge, reduction pot is mounted on lathe. Chips from the lathe containing $MgCl_2$, Mg impurities go to vacuum retort.





5 **Vacuum retort** produces pure sponge by distilling off the impurities.

6 **Fresh from vacuum retort,** pure sponge is weighed right in its basket for process accounting.

7 **Pure sponge** block is broken up for final cleaning and packaging.

techniques at Boulder City, Nevada

8 **Sponge crushing and sizing,** and the removal of tramp iron take place here. USBM does not produce ingots at the Nevada Experimental Station.

move vanadium and iron, sulphur chloride and sulphur will be present.

Metallic copper readily removes vanadium, iron, chlorine and sulphur, while a good fractionating still removes all other impurities except the silicone which fortunately occurs in rather small amounts corresponding to about 0.02 to 0.03% silicon in the resulting sponge. Purified $TiCl_4$ should be water white and free of hydrolysis products. A saying in the industry is that "the best tetrachloride is none too good."

$TiCl_4$ Costs

$TiCl_4$ derived from the carbo-nitride sells for about 35c per pound in carloads. One producer about to enter the market on a sizeable scale, and who will use rutile as a raw material, has quoted about 15c when rutile is $120 per ton. This difference of 20c per pound means a reduction of at least 80c in the raw material cost of sponge. Careful cost estimates by the author and confirmed by others indicate a probable total production cost of 7½ to 8c per pound with rutile at $120 and chlorine at $60 per ton. It would seem that within a few years, titanium producers should be able to purchase $TiCl_4$ at 10c, thus making possible the production of sponge at a total cost of about $1.

Before closing this discussion, it should be mentioned that good quality $TiCl_4$ is available in England for £130 per metric ton equivalent to 16.25c per pound. It is produced from Australian rutile. A Japanese chemical company that produces a slag similar to Sorel slag, but which is said to carry 90% TiO_2, is offering crude $TiCl_4$ c.i.f. West Coast ports in ICC-5A drums, duty paid and drums included, for 17.65c and c.i.f. New York for 17.95c. The value of the drums alone accounts for about 2.5c of this amount.

Controlling factor in the price of Australian rutile may be the extensive deposits of anatase, another form of TiO_2, in Hawaii. Anatase is nearly as dense as rutile and the deposits may be beneficiated by simple gravity methods. It is known to chlorinate as readily as rutile.

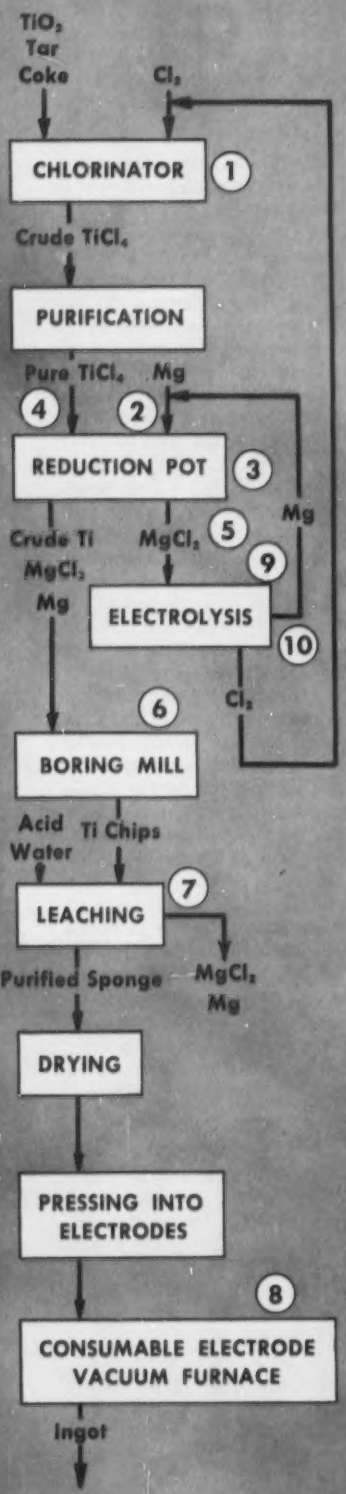
Reduction of $TiCl_4$ by Mg

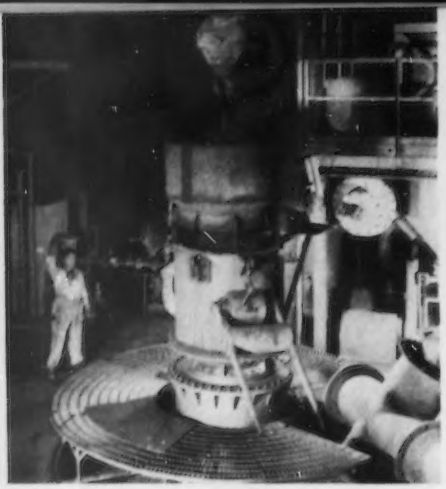
All commercial sponge made today in the United States is the product of the reduction of $TiCl_4$ by magnesium. The method may be termed the standard Kroll process as developed by F. S. Wartman at the Bureau of Mines, and has been modified in detail by the various producers.

Making the reduction involves reacting purified $TiCl_4$ and Mg at known rates in an inert atmosphere at controlled temperatures in an inexpensive vessel having a long life and which is

HOW TMCA ADAPTS THE KROLL PROCESS

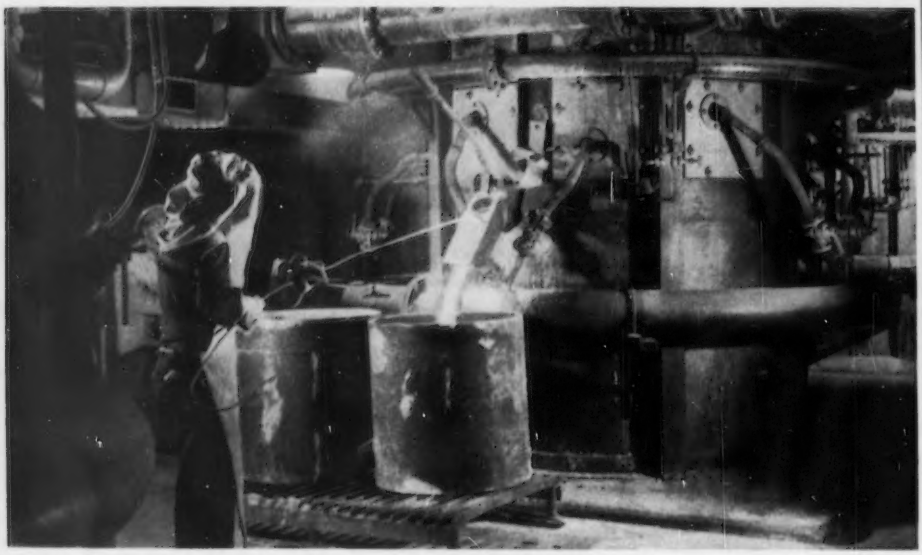
(Circled numbers refer to photographs at right.)





1 **Rutile sinter** is charged into a static bed chlorinator to produce $TiCl_4$ vapor which will subsequently be condensed into a liquid.

2 **Pig magnesium** is charged into the alloy steel reduction pot. Most of the magnesium is recovered later.



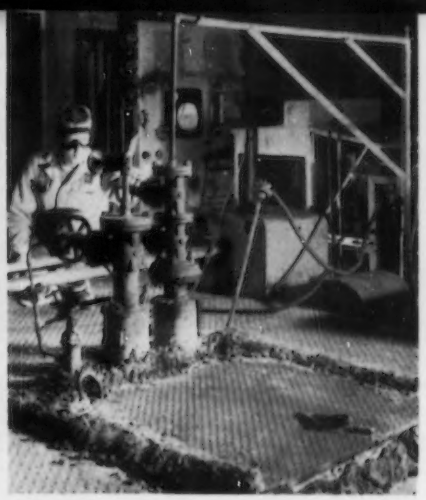
5 **Magnesium chloride** (MgCl), a reaction product, is drained from the bottom of the reduction pot. Both magnesium and chlorine will be recovered for recycling.

TMCA produces 7500 tons per

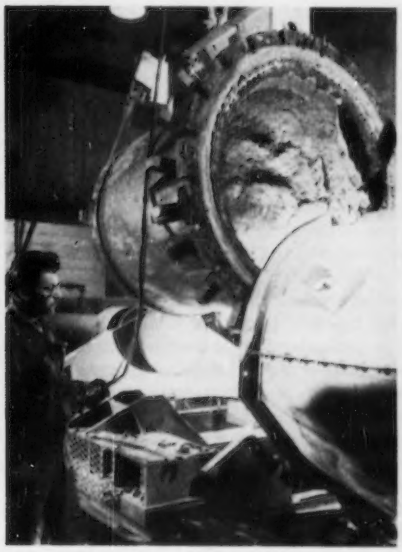
8 **Blended sponge** is melted into 4-ton ingots.

9 **Magnesium chloride** from reduction pot is charged into electrolytic cells for recovery Mg, Cl.

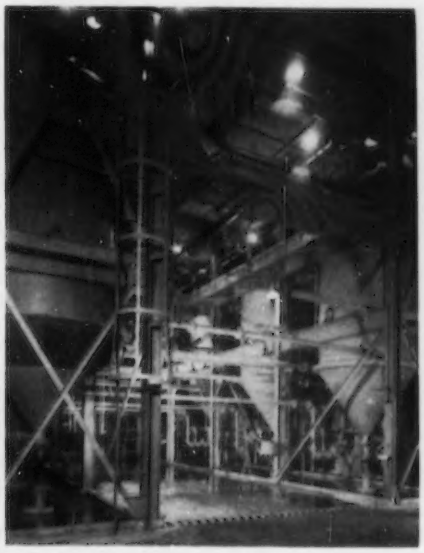
3 **Sealed reduction pot** is lowered into furnace where heat initiates the Mg-$TiCl_4$ reaction.



4 **Titanium tetrachloride** ($TiCl_4$) is piped into reduction pot. It reacts with the magnesium to form crude titanium sponge.



6 **Porous sponge** produced in reduction pot must be bored out.



7 **Titanium chips** from boring machine are leached clean of residual Mg and MgCl.

year at Henderson, Nevada

10 **Molten Magnesium** is ladled from electrolytic cells into pig molds. These pigs are recharged into reduction pots. Chlorine goes to rutile chlorinator.

easy to open and close and from which the reaction products are readily removed, said vessel being placed in a furnace so designed that the vessel may be both heated and cooled.

Bureau of Mines practice is essentially as follows. Cleaned solid bars or ingots of Mg are charged to the reaction vessel or pot, the cover is placed in position and sealed, and the vessel is evacuated and charged with an inert gas. After placing the assembly in a suitable furnace and allowing sufficient time for at least some of the Mg to become molten, purified $TiCl_4$ is fed continuously until all available Mg is just consumed.

As the reaction is highly exothermic, the furnace is usually not heated during the addition of the $TiCl_4$ except to make sure that the bottom of the pot is kept about 50 deg C above the melting point of the by-product $MgCl_2$ which is tapped to a slag-pot at suitable intervals. Rather the vessel is maintained at a predetermined temperature by the controlled rate of $TiCl_4$ feed, at which point the rate of dissipation of heat through the vessel walls equals the rate at which reaction heat is generated. Pot temperature as measured externally may be from 750 to 1,000 deg C depending on the desire of the producer.

At the end of the reaction, heating may be continued for perhaps an hour after which the pot is removed from the furnace and allowed to cool to room temperature. It is then opened in a dryroom where the humidity is maintained at a dew-point of at least –40 deg C, and the contents are cut out on a large lathe or a boring mill. Chips so produced are caught in a basket and are ready for purification by vacuum distillation.

There are many possible modifications of the above practice.

Choosing between electrolytic magnesium and that produced by thermal reduction is easy, since the former costs roughly only half as much as the latter. Electrolytic magnesium is not so pure, but the essential difference as far as titanium is concerned, lies in its higher content of manganese. Manganese is a normal constituent in some titanium alloys, and even in unalloyed titanium it does not measurably increase the hardness in the amounts encountered—about 0.07% in the sponge.

Magnesium is obtainable in self-palletizing pigs, 20-lb notched ingots, and cylindrical pigs, in order of increasing price. All are likely to have shrinkage cavities which are sometimes sealed over and therefore must be reamed out before or after pickling in dilute acid in order to insure that all oxidized surfaces have been removed. Pickling is followed by rinsing, drying,

storage in the dryroom and prompt use to avoid the introduction of oxygen as MgO through re-oxidation of the fresh surfaces. A fourth form, the so-called extruded bars, should have no shrinkage cavities, as they are the result of sawing off lengths of a continually cast and extruded bar.

Extensive tests have shown that pickled and reamed magnesium ingots, quickly rinsed and dried, are essentially free of oxygen—in other words, magnesium oxide has a negligible solubility in magnesium, and inclusions are rare.

Pickling and reaming of the ingots could be avoided by charging clean molten magnesium from the middle portion of a holding vessel where settled magnesium would be maintained somewhat above its melting point and under a slag or inert gas cover to avoid oxidation. Pumping fluid magnesium at controlled rates is a simple procedure.

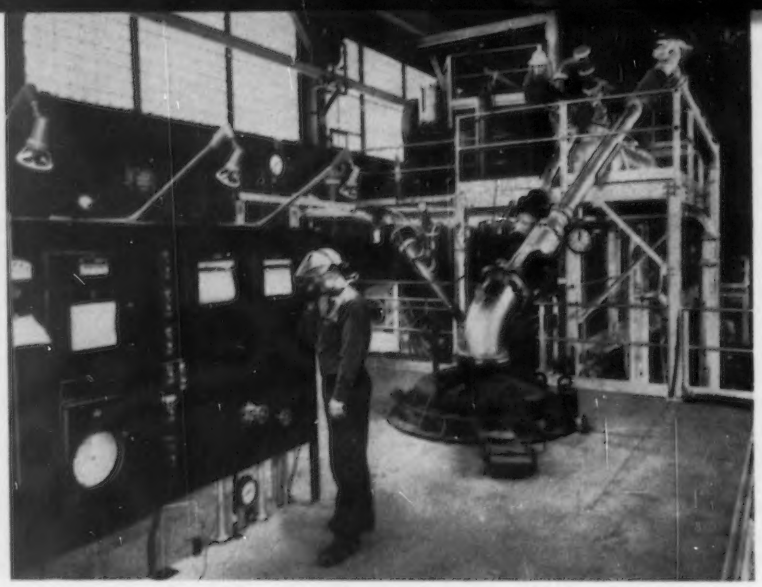
Solution of one problem often poses another, and in this case the charging of solid ingot has a distinct advantage over the use of molten Mg in at least one respect. If solid Mg has been charged, part of the reaction heat is absorbed as latent heat of fusion of the Mg so that $TiCl_4$ may be fed at higher rates during this period, which in turn shortens the time required for reaction and allows greater throughput in given equipment.

On the other hand, Mg tends to be trapped by titanium sponge as the latter builds up in the pot. Even though much care be taken to float the Mg on the molten $MgCl_2$ as high as possible, at times much Mg is covered over by titanium and cannot be reached by the $TiCl_4$.

Average consumption of Mg over thousands of runs at the Bureau of Mines lies between 80 and 85% of that charged. One way to better this efficiency would be to add Mg in increments as the reaction proceeds—either as solid or liquid.

Small bars of Mg are added by some operators through a suitable lock and toward the end of the reaction to make sure that any lower chlorides of titanium which may have been formed when little or no Mg was available, are reduced. These lower chlorides are most objectionable when the pot is opened as they fume badly, causing much trouble to the operators. Such additions, however, are a possible source of introduction of air as well as MgO, and pose other difficulties such as fume around the furnace.

Molten Mg can be added to the pot as required through a closed system thus avoiding the above difficulties. By this means, Mg efficiencies have been raised to over 90%, together with the added advantage of producing as much as 50% more sponge per batch, owing to the relative space required by loosely packed Mg ingot as compared to sponge in place.



Sodium process jumps from pilot plant to....

AT NIAGARA FALLS Electro Metallurgical Co.'s research lab worked out a sodium reduction process for producing titanium sponge.

Sealing The Pot

When closing pots the Bureau of Mines practice has been to seal the pot lid to the pot by welding the seam at the flanges, taking care to get very little weld penetration at the seam itself. The bead is easily removed by grinding when the pot must be opened. This type of seal can be most satisfactory and is believed to be the least expensive. Others have used a bolted joint with a corrugated metallic gasket, but it is believed that this procedure is rapidly disappearing. There is no assurance that the joint is gas-tight because of dissimilarity of coefficients of expansion.

Helium as the inert gas, is preferred to argon even at a greater cost since its much higher heat capacity assists markedly in dissipating the reaction heat and thus shortens the cycle.

Pot proportions and details, furnace design, method of tapping molten $MgCl_2$ and other items, vary from one producer's plant to another. Mild steel pots are cheap and have a long life at moderate temperatures. Alloy pots with thin, mild steel liners have been used at higher temperatures. Alloy pots which have nickel as a constituent cannot be used without protection because molten magnesium dissolves the nickel and so destroys the structure of the alloy. Some furnaces are fuel-fired while others are heated electrically, depending solely on the choice of the designer.

The furnace itself presents an unusual problem in that heating and cooling are required simultaneously. Heat must be dissipated from the reaction zone while the pot bottom must be maintained at about 700 deg C to be able to tap the slag.

The author designed and operated a successful, two-compartment furnace in which the bottom heating zone was separate from the upper heating and /or cooling zone. Both zones were heated until the reaction was well under way, when the fires were turned off on the upper zone. Furnace doors could be opened to permit rapid circulation of air around the upper part of the pot. A distinct saving in time, with better temperature control was noted.

It is unfortunate that iron is the only "refractory" material that can be employed in contact with titanium because it sharply limits operating conditions. To make low iron sponge one must control the temperature at about 780 to 800 deg C, thus limiting the ability to dissipate reaction heat but obtaining long pot life. At the upper temperature limit, or upwards of 1,000 deg C, the time required for the reaction is less because of the ability to liberate heat more rapidly, but pot life is greatly shortened and the sponge is found to contain much more iron. The producer must therefore balance the advantages of increased throughput against increased pot costs and his ability to dispose of high iron product.

Design of a dryroom again is open to choice. The essential requirements are tightness, well sealed doors in the air lock, enough room for the equipment and its maintenance and opera-

full-scale production

AT ASHTABULA, OHIO, a new plant with a capacity of 7,500 tons of titanium sponge per year is just getting into operation.

tion, and the ability to maintain, at all times, a humidity corresponding to a dew-point of at least minus 40 deg C (0.555 grains moisture per pound of dry air).

Reduction pots are opened, emptied, re-charged with Mg and closed in the dryroom. The welded bead which seals the cover joint may be placed and may be removed by grinding outside of the dryroom if the cover is held tightly in place by C-clamps. In the dry desert climate of Boulder City, where the absolute humidity is of the order of 10%, purification retorts may be charged outside the dryroom, but in moist climates the dryroom must be large enough to accommodate this step.

Purification of Sponge

The reduction product contains all of the Mg not consumed as well as any $MgCl_2$ not drained off. A typical composition is: Ti (sponge) 65%, Mg 10%, $MgCl_2$ 25%.

To meet current Government specifications, Mg must be reduced to 0.10% and chloride (Cl_2) to 0.15%, making certain at the same time that no oxygen or nitrogen is added to the titanium, either from air or moisture at elevated temperatures.

In the early work at the Bureau of Mines, during which Wartman was making the Mg reduction in larger and larger equipment to a point where it could be considered commercial, all sponge was purified by leaching out the Mg and $MgCl_2$ with HCl solutions at lowered temperatures. This step required repeated reduction in size followed by leaching after each reduction, together with means for cooling. The product, after drying, was compacted at very heavy pressures. The compacts were sintered at elevated temperatures in a vacuum furnace, yielding a product with densities closely approaching solid metal.

But, as larger reduction batches were successfully made, sponge became more metallic in appearance as well as more massive, and since it could be reduced in size only with great difficulty, leaching to low impurity levels was not as satisfactory as it had been. Purification by vacuum distillation provided an answer.

Lathe chips of the reduction mass drained of most of the by-product $MgCl_2$ while in the furnace, and contained in a perforated steel basket, are charged to a mild steel retort. After closing, the lower half of the retort containing the chips is placed in an electrically heated, evacuated furnace. The upper half of the retort is water-jacketed and serves as a condenser for the impurities. Distillation takes place at a pressure of 10 to 50 microns furnished by a mechanical pump, and at a temperature of about 900 to 925 deg C. Most of the impurities distill from the sponge in the first few hours, but many hours are required to reduce their level to satisfactory limits.

When the process is finished, the vacuum is released with an inert gas and the retort is removed from the furnace and allowed to cool to room temperature. The purified sponge is broken out of the basket, crushed to size, sampled and packed in drums.

This vacuum distillation step requires little labor or supplies, and only two to three cents' worth of power per pound of sponge for heating, driving the vacuum pumps and for pumping cooling water. Cost of the equipment is more serious, as it amounts to nearly $500 per ton-year capacity. Maintenance is low.

Since vacuum furnace and vacuum pump specifications vary from one manufacturer to another, details of the equipment used vary from plant to plant, although the process used is essentially the same, but two distinct process variations should be noted.

To reduce the lengthy time required for complete distillation, one operator has hit on the scheme of distilling over the major part of the impurities, which takes only a few hours, and then finishes purification by leaching the cooled, nearly purified sponge. This combination of processes, if successful, would require only a third as much vacuum distillation equipment as well as only a modest amount of leaching equipment since the work to be done is less.

Another variation is to vacuum-distill from the same vessel in which the reduction is made, without transfer of sponge. This scheme has merit because (1) no dryroom is required since the reaction mass is not exposed to moist air until finally purified when it does no harm, (2) heat transfer to the mass *in situ* is better because it is continuous rather than a mass of loose chips and therefore conducts heat better, and (3) some of the impurities are contained in multitudes of capillaries in the sponge structure, and since they have not been disturbed and sealed by the lathe tool, the impurities are liberated more easily during distillation.

Disadvantages of this system are (1) the equipment is about as expensive as for the "standard" method, (2) the finished sponge is more difficult to cut from the mass, because impurities, when present, act as lubricants for the cutting tool and so minimize overheating with consequent increase in hardness, (3) fires, causing loss of sponge, are more likely unless elaborate precautions are observed, and (4) if liners are used in alloy vessels, distortion caused by heat soon causes loss of the essential fit between liner and vessel.

Purification by leaching with HCl is believed to be no longer in use. Instead, strong nitric acid solutions, with or without salt additions, are being used with fair success. Leaching is done hot, followed by washing and drying. Although the leach solution is a vigorous oxidizing agent, insufficient oxygen is added to the metal to cause undue hardness. Quality would be even better however, were vacuum distillation employed.

While the equipment required is relatively inexpensive, actual cost of

The Role of Frank Wartman

Only about 20 years have passed since Wilhelm Kroll first made ductile titanium. In 1938 the U. S. Bureau of Mines decided to investigate the possibility of commercial production of titanium and assigned Frank Wartman, then working in the Tucson, Ariz., laboratories, to head the project. After investigating a number of proposed methods, Wartman selected the Kroll process as having the most promise.

Frank Wartman deserves great credit for having developed Kroll's method from a laboratory curiosity to one having commercial possibilities. Without his keen judgment and perseverance, it is likely that titanium would still be unknown to the public. At the very least, the process should be known as the Kroll-Wartman process.

M. G. Mastin

leaching may be supposed to be greater than that for vacuum distillation because of the cost of acid and other supplies. A further disadvantage of the acid leach is the fact that titanium readily takes up hydrogen liberated as the excess Mg is dissolved. This requires a de-hydrogenation step to keep the product within current hydrogen specifications—0.005%, because of the danger of embrittlement.

Reduction and Purification of $TiCl_4$ by Na

For some reason, Kroll apparently did not claim the use of any metal of the alkali group as a reducing agent for $TiCl_4$ in his patent application. Of course, of this group, sodium is the only metal cheap enough to warrant consideration.

Anyone considering the use of sodium instead of magnesium must consider the following factors:

(1) Sodium is quoted at 16c per pound as compared to Mg at 32.5c, before freight or other costs. As Na is monovalent, it takes two sodium atoms to do the work of one Mg atom. Considering the slight difference in atomic weights, 32c worth of Na will do the work of 34.37c worth of Mg on the basis of 100% efficiency. Since the user of Mg can scarcely obtain better than 90% efficiency while the Na user enjoys essentially 100% efficiency, the difference in favor of Na is nearly 6.5c per pound of titanium under the above price assumptions. Only a year or so ago there was little price differential, but the cost of Mg has risen 20% while Na has remained steady.

(2) It is believed that everyone proposing to use Na, either in this country or abroad, intends to purify the crude Ti by leaching rather than by vacuum distillation. Further, for reasons to be discussed below, molten NaCl is not ordinarily tapped from the reaction vessel, so that the entire quantity of by-product NaCl is passed to the leaching operation, whereas about 90% of the $MgCl_2$ resulting from the Mg reduction is tapped off molten and ready to use for cell feed without further treatment. The significance of this statement is that the sodium user, if operating an integrated plant, must evaporate his solution of NaCl to dryness and melt his salt to obtain equivalent cell feed. This tends to lessen the difference in efficiencies between the two metals, costwise.

(3) Sodium is now obtainable as solid pack in drums or in tank cars, and may be melted and run into storage without contact with the air, thus avoiding oxidation. However, there is always some sodium oxide present, which must be removed by filtration or other means. Sodium oxide is believed to have a very low solubility in molten sodium.

Molten sodium is readily handled through heated lines, and may be pumped and metered without contamination, using special equipment.

(4) Sodium reduction liberates about 70% more heat of reaction per pound of Ti than the Mg reduction. This fact limits the rate of reaction in any given equipment, and must be given serious attention by the designer.

(5) Sodium will reduce $TiCl_4$ at temperatures as low as 200 deg C but Mg will not react rapidly at much below 700 deg. It is therefore perfectly possible to conduct the sodium process at temperatures well below the melting point of the by-product salt (801 deg C).

One American firm proposes making the sodium reduction at over 800 deg C, i.e. above the melting point of salt. This produces a fairly coarse sponge not too much different in appearance from Kroll sponge. He will purify by leaching with water.

One foreign producer reduces at 750 deg, about 50 deg below the melting point of salt, apparently batchwise and with agitation. The granular product containing 17% Ti and 83% salt is cooled and washed in a continuous system. The sponge is bright and metallic in appearance, and is obviously made up of aggregates of very small particles. Essentially all of it will pass a 20-mesh screen, but it is pelletized before further processing.

Titanium produced by low temperature reduction is usually a fine powder. Such powdery material is extremely reactive and cannot safely be exposed to air or water without suffering severe oxidation. These powders do, however, sinter together if heated for some time. If the true cost of purification by vacuum distillation were generally known, purification by this technique could be used advantageously. The salt would emerge as a solid, thus avoiding evaporation of the usual brines.

Finished Product

No matter how made, the purified sponge must be prepared for melting to ingots. The melters compress the sponge, with or without alloying ingredients, into bars which serve as consumable electrodes in the subsequent arc-melting step. For this reason, the producer must size his sponge to conform to the melters' requirements—usually all minus ½ or ⅜ in. plus 20 or 30 mesh. Coarse sponge must be crushed to this size and granular sponge must be pelletized. The producer of the smaller particle sizes has the advantage in that the titanium can be better compounded with alloying ingredients before pelletizing, which should result in more uniform composition in the ingot.

In any case, the sponge must be adequately sampled both for analysis and for determination of hardness. The Bureau of Mines has worked out satisfactory procedures for these steps, which are used whenever sponge is offered for sale to the Government, when the Bureau acts as referee. The industry is urged, while it is young, to adopt some common set of standard procedures of sampling and analysis to avoid the almost certain confusion which will otherwise occur.

Sponge is commonly stored and shipped in one trip, light, open-mouth steel drums, using a gasketed, clamp-on cover. Titanium so held should not

deteriorate with respect to hardness over any reasonable storage period.

Other Processes

Much has been said about the imminence of an electrolytic cell as a commercial produer of titanium. A great deal of research has been devoted to this scheme for at least the past five years, and is still going on, although the number of researchers has diminished. Most proposed cells use molten electrolytes which must be maintained at several hundred degrees above room temperature, and employ $TiCl_4$ as the raw material. Good cathode coatings have been obtained at reasonable power efficiencies. In fact it has been shown that high oxygen titanium used as the anode will yield very low oxygen metal at the cathode, and therefore might be a useful means of reclaiming scrap titanium—one of the major problems.

Stumbling block to the electrolytic process lies in the apparatus required to strip the cathode while hot, without contamination of the Ti by air or moisture, or to remove the hot cathode from the cell, cool it in an inert atmosphere, and transfer it through a lock to the open air where it may stripped of product, then returning it to the cell through the same path. This might not be too difficult to design and operate for a single cell, but when one contemplates the number of cells required to make, say, 10 tpd, the probable complexity of the layout is staggering. At any rate, we have no commercial electrolytic installation.

J. P. Levy, in England, has patented a scheme which involves a constantly circulating, high velocity stream of argon kept moving by a booster pump. A side stream from the main flow passes over molten Mg near its boiling point. Just downstream from this point, $TiCl_4$ vapor is introduced and the side stream then enters the main stream and immediately passes through two cyclones in series where the powdered product is removed. It is claimed that the system operates for long periods without build-up of product on the walls. This system appears to have merit, although much development work still remains to be done. It could just as well employ Na as Mg.

A company in New England is reported to have developed an electrolytic cell which employs a molten organic compound of Ti as raw material. The cell is reputed to operate at 205 deg C, and plates Ti on a slowly withdrawn starting wire which may be titanium. A current efficiency of 98% is claimed.

Practically all processes so far proposed use $TiCl_4$ as a raw material. This is a primary disadvantage, in that it takes four pounds to make one pound of product. This means that we cannot possibly hope to reduce the cost of this raw material much below 40c per pound of metal as long as we use $TiCl_4$. Obviously 6c TiO_2 equivalent to about 10c per pound of titanium would represent a relatively enormous reduction in cost, so that much research has been expended along this line. Thermodynamic calculations indicate that TiO_2 may be reduced by Mg to a metal containing perhaps 2% oxygen, and that further reduction by metallic calcium could reduce the oxygen content to about 0.3%. This goal was reportedly approached, but never attained. Of course we now know that the oxygen must be reduced to at least 0.1% to yield an acceptable metal.

Future Possibilities

There are several possible schemes that seem to offer promise of producing better metal at less cost.

The iodide process in a sense is ideal. If only iodine was as cheap as chlorine, or if it could be used repeatedly at essentially 100% efficiency, or if the amount of metal made at a given time could be much larger, we should be able to produce metal of 65 BHN at low cost.

Thermal decomposition of $TiCl_4$ does not appear to be practical because of its stability. It does seem, however, that there should be some compound of titanium, probably not currently known, that would be capable of yielding ductile metal on heating to reasonable temperatures.

This does not necessarily exclude organic compounds containing carbon, oxygen or nitrogen, as they might be made to decompose at such low temperatures that contamination of the metal would be avoided. The compound must be easy to make, cheap, and should preferably contain a high percentage of titanium.

If titanium is to receive the place in industry which it deserves, we cannot be satisfied with $1 sponge. Almost certainly, sometime, somewhere, a set of circumstances will arise whereby an individual or a group will be enabled to reduce the cost to a level comparable with aluminum or magnesium although that time now appears to be remote. In the meantime we possess proven and dependable methods for making all the titanium we need for defense purposes and some civilian uses.

Meet Mastin

BE IT FOR THE SOLUTION of a tough production problem in his busy titanium consulting practice, or for the writing of a practical appraisal of the problems (and answers) of titanium technology as in the article below, Mike Mastin can tap over 40 years of experience as a chemist and chemical engineer in plant design and operation for the answers.

Marion G. Mastin

Beginning with graduation from the University of Minnesota in 1913, the Mastin career includes 17 years with Westvaco Chlorine Products Co. and the position of works manager for a Manhattan District plant at Oak Ridge, Tenn. When he subsequently moved to Boulder City, Nev., to design and operate plants for the production of synthetic organic chemicals, he decided to become a permanent resident of the Southwest.

Mr. Mastin waded into titanium in May 1951 when he was employed as a consulting engineer with the Bureau of Mines to design a titanium pilot plant. He stayed on to supervise its erection and then to operate it from July 1952 until February 1954 when he left to start his own consulting practice.

Just last summer, he spent 2½ months in Europe to start up a new Kroll process plant in England and to make a survey of progress in titanium research in nine European countries.

COMPLETE INTEGRATED TRAIN for mucking out a heading round, includes seven 5½-ton bottom dump cars, diesel locomotive, a two-drum, air-operated slusher hoist, bucket and pull-back supporting sheave block on end bracket of train.

For Faster Tunnel Driving—Meet

JOHN S. WRIGHT
ROGER V. PIERCE

SOLVING ONE of the major headaches of driving headings by making it feasible to load full trains of cars rapidly without switching devices, car passes and other special equipment of that type, the Whup d'Whup has proved its practicality and effectiveness in 2,100 ft of tunnel work handled since October 1955.

From performances observed, it is safe to predict that this development will have far-reaching effects in future planning and driving development drifts, crosscuts and tunnels. It could well be instrumental in reorganizing present methods of driving exploratory headings and will be applicable in driving slightly dipping winzes and inclines.

The Problem

One of the main problems in driving these various exploratory headings and an item that has contributed a major percentage of the delay is the time consumed in switching cars in the heading.

Since the development of the rail-mounted, air-operated, overshot mucker, the loading of the broken ore or waste from the drift heading into cars has been at a more rapid rate than it has been possible to maintain empty cars at the loader.

In these single track mine headings of restricted cross section there have been numerous ideas developed and tried to cut down or eliminate the delay in keeping the loaded cars on the move and an empty at the mucking machine. Switching devices, such as automatic car passes, overhead-type switching monorails, California switches, lifting and moving mechanisms of one type and another, have been tried. There are inherent disadvantages with each car switching method. Each of these switching arrangements calls for cutting out additional head or side room from the drift. There is the added cost of installing these special devices, and during installation the advance in the heading is usually at a standstill.

A New Approach

San Francisco Chemical Co., one of the largest producers of phosphate from underground mining and the largest suppliers of commercially produced phosphate for the open market, found themselves face to face with this loading problem. The nature of their underground deposits required the driving of as much as three to four miles of drifts and adits per year. From time studies, it was determined that the drilling and actual mucking operations of the complete cycle were the most efficient and that car servicing was the item that was contributing the greatest amount of delay in obtaining over-all speed.

Time studies indicated that the wheel-mounted mucker would load two to three tons of broken rock into a car per minute. However, it was also found that two to three hours' total time was required to load out a 45-ton full round from the drift face. The major time loss was due to car service and transfer.

Early in June, the management group discussed the possibility of designing a train of cars that would hold an entire drift round with features that would allow the muck to be transferred from the lead cars back along the entire length of the train.

R. B. Austin, chief engineer of Coeur d'Alene Hardware & Foundry Co., Wallace, Idaho, was contacted, the entire idea was discussed with him, and the desirable features that were to be included in the machine were emphasized. After Mr. Austin visited the operation and discussed the ideas offered, the machine was engineered and developed. When the designs were carefully considered and suggested changes formulated, the first train of cars was built in the Coeur d'Alene Hardware & Foundry shop.

Mr. Wright is underground mine manager with San Francisco Chemical Co. at Montpelier, Idaho. Mr. Pierce is a consulting mining engineer with headquarters in Salt Lake City, Utah.

AT HEADING FACE, overshot mucking machine loads front end of train. Slusher moves rock over grizzlies, aprons at car-ends to all cars.

BRACKET supporting slusher sheave block is raised to operating position by hoist.

the Whup d'Whup

This machine is the one in use at the present time and is shown in the accompanying photographs. On the basis of the developed machine, patent applications have been made. Shortly after the machine went into operation, someone said, "It whups it back from the face," and thus it was dubbed the "Whup d'Whup."

In the over-all cycle in driving this particular tunnel, the drilling has been accomplished with a two-machine jumbo. Each machine has a 10-ft feed, and this has cut down time losses due to changing steel. The greatest source of trouble has been in loading holes in the ravelly ground. Even so, as much as a 40-ft advance has been made in 16 hr in this 9x9-ft heading. With the refinements that will be incorporated in the next machine—some of which are listed below—and with further refinements in multiple drill jumbos under consideration, it is not at all unreasonable to expect a completed 10-ft cycle in 2½ hr.

Future Units

In the next units now being laid out for construction, the following further improvements are planned to increase the speed of the project:

1. Faster rope speed will be used on the slusher hoist.

2. Larger cars with a minimum of wasted space between the cars will be furnished.

3. By operating the slusher hoist by remote control, the slusher operator can better observe the action of the mucking machine and increase the effective performance of both machines.

4. Flexible overlap on cars will allow more freedom in making turns.

Earlier Attempts

Several attempts have been made during the last several years to load a complete train without switching any cars. Large, bulky steel loading ramps of sufficient length to extend over the entire length of a train of cars have been tried. The muck from the face of the drift was pulled up such a ramp and stacked back along its entire length by a slusher bucket. Then, as the bins of the ramp were tripped, the entire train was loaded at one time. There were also several instances where long conveyor ramps that extended over the full train were built and tried. In nearly every case, the problem of protecting this equipment during blasting substantially discounted any savings in time that could be made with the machine.

Numerous man-hours were expended in cleaning up ahead of the machine and in laying track so that the machine could be moved closer to the muck pile. These methods all had drawbacks and did not offer enough advantages to compete successfully with switching the individual cars.

Early in the 1930's, scraper hoists were popularly used in driving drifts and were used with a wheel-mounted steel loading ramp. During this time a multiple car scraper ramp was designed and built. In this structure a scraper hoist pulled the muck up a slide and back to be distributed into the several cars of the train. In one case the cars formed the extension of the slide and, when loaded, they were disconnected from the ramp and moved out to be dumped. This did not enjoy wide acceptance because of the inability of the scraper to compete with the overshot loader and the time required to make a final face cleanup. Too much time was lost in moving the scraper ramp out of the drift prior to blasting. The equipment was not readily portable, it was extremely bulky, and it was difficult to move supplies in around the loader. The above idea has recently been tried again in the Scandinavian countries. This development took place in the United States early in the 1930's and was written up in "Modern Methods for Scraper Loading and Mucking," published in 1938.

In general, the entire operation did not prove to be competitive with the wheel-mounted, overshot loaders that have since enjoyed wide adoption. The problem has remained the same, and it has long been desirable to develop some type of train with capacity large enough to hold an entire drift round and include a muck transfer that would eliminate switching of cars. The Whup d'Whup is one answer.

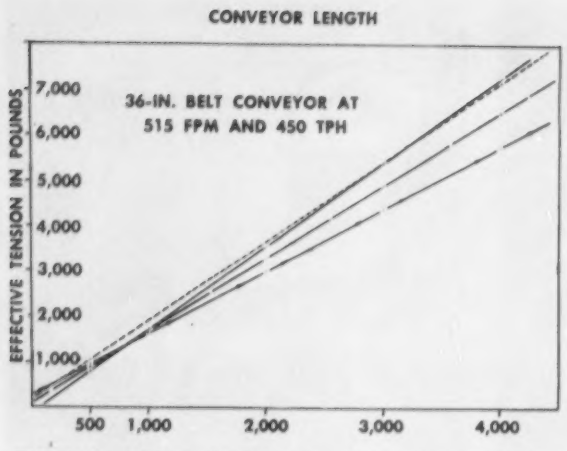


FIG. 1. Comparison of belt horsepower formulae used by four manufacturers for constant speed and capacity.

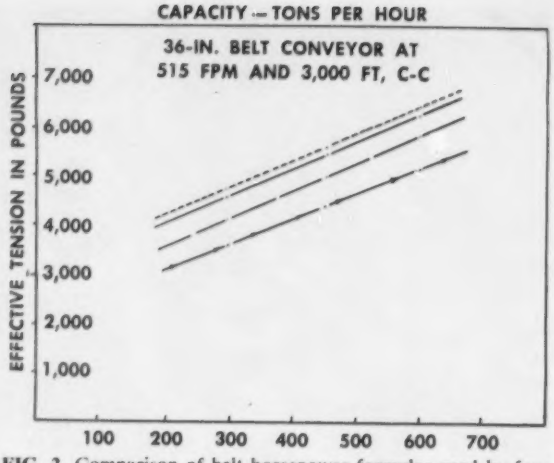


FIG. 2. Comparison of belt horsepower formulae used by four manufacturers for constant speed and length.

How Belt Conveyor Research

A. W. ASMAN

INCREASING USE of belt conveyors to handle mine products and materials exerts continual pressure on the mining industry and manufacturers of conveyor equipment to improve designs.

Pennsylvania State University, Department of Mining has been conducting research on belt conveyors to establish more accurate methods for designing them, and to add to the knowledge of their operation and maintenance. Hewitt-Robins, Inc., sponsored this project. As a result of this research, a new concept of horsepower component determination based on belt tension differentials was developed. Table I lists belt conveyor installations where studies were made.

The ideal test belt conveyor would be several thousand feet in length and have a maximum tension of at least 40,000 lb. Also, this conveyor should be horizontal and have a variable feed rate of more than one material. Data from such a field belt conveyor combined with laboratory information would permit accurate analysis. Since this type of conveyor was not available, many field locations were visited with emphasis on the 36-in. width since this size is in most common use. An alternate would have been to erect a closed circuit system in the laboratory. Either method had limitations and the first was selected as having the best possibilities. The entire research program has provided excellent training for both staff members and students.

Manufacturers of conveyor belting and machinery basically have been using the same horsepower formula. As more information became available from field installations, factors in the basic formula were modified. Practically all conveyors are designed today by adding together the horsepowers required to move the empty belt, move the load horizontally, and elevate the load. In selecting size of drive motor, the first two elements are relatively unimportant if the last is large. However, it is the combination of conveyor belting, machinery and drive, that determines optimum design of the installation and insures trouble-free operation. Fig. 1 shows the comparison of horsepower formulae used by four of the belt conveyor manufacturers, for variable length, and Fig. 2 shows similar data for variable capacity.

Conveyor Operation Analysis

Before belt conveyors can be designed to fill requirements of field operating conditions, it is necessary to understand certain principles of operation:

1. Energy requirements for the belt conveyor are expressed by

$$\mathbf{HP} = \frac{\text{Speed} \times \text{Tension}}{33{,}000}, \text{ where}$$

HP = Input horsepower to drive shaft
Speed = Linear belt speed in feet per minute
Tension = Effective tension at drive pulley in pounds.

2. Belt speed is determined by drive pulley center diameter and neutral axis of the belt at the drive pulley. Fig. 3 shows a field method for obtaining drive pulley speed of rotation.

3. Effective tension is a measure of the dynamic force in pounds required to move the loaded conveyor.

4. Belt speed and tension both change gradually along the conveyor from the drive end to the tail, with speed at a minimum where tension is lowest. The one-foot circumference wheel actuates a switch which indicates belt travel distance, as shown in Fig. 4. Some of the counting devices and other instruments used in field studies are shown in Fig. 5.

5. Initial slack side tension is required to prevent slipping between the drive pulley surface and the belt.

The conveyor belt rides on troughing and return idlers which consume specific amounts of energy. Fig. 6 shows the apparatus used in the laboratory to test rolls. This energy consumption is represented by so many pounds of tension imparted by the drive motor. At high loads, roller requires less force to turn than ball bearing idlers. Friction losses in bearings increase slightly with rotational speed. Thus for any conveyor, the power required to turn idlers is about the same per unit of length from head to tail.

In addition to turning the idler rolls, the effective tension is used to move the loaded and empty belts. Fig. 7

Mr. Asman is head of the department of mining, Pennsylvania State University.

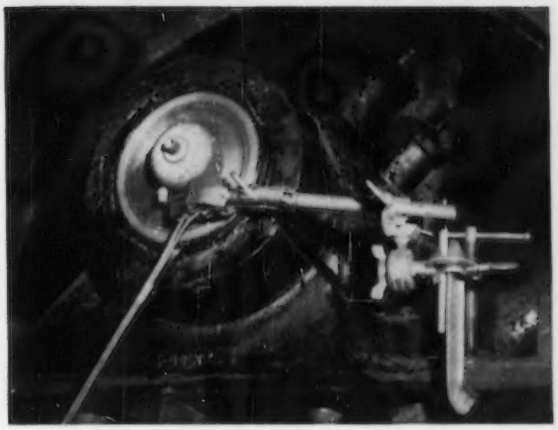


FIG. 3. Roller actuated micro-switch and single position cams for measuring belt conveyor terminal shaft speeds.

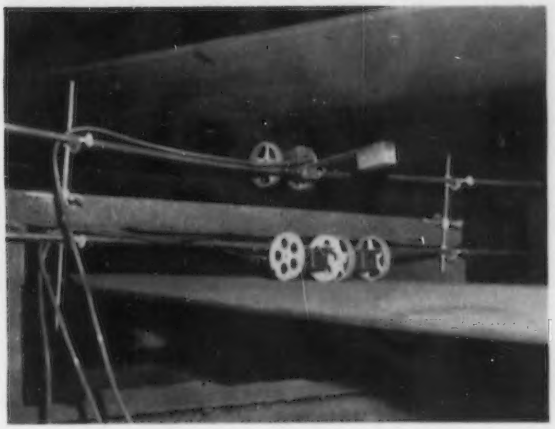


FIG. 4. Rubber and scored faced rotary switches for measuring belt speeds of carrying and return strands.

Contributes to Better Design

Table I Specifications for Belt Conveyors Studied

Conveyor	Material	Width (in.)	Capacity (tph)	Speed (fpm)	Belt (oz)	Construction (ply)	Length (ft)	Lift (ft)	Motor (hp)	Location
1	Stone	18	70	156	32	5	113	33	7½	Pa.
2	Coal	36	300	375	36	4	831	53	40	Pa.
3	Coal	36	600	435	28	7 x 5	984	13	60	Pa.
4	Stone	48	1,050	490	Cotton	Cord	818	175	250	Pa.
5	Coal	42	800	550	42	5	1,667	9	150	Ill.
6	Coal	48	1,150	485	Steel	Cable	1,640	477	750	Ill.
7	Coal	36	600	450	28	7 x 5	425	32	60	Pa.
8	Coal	36	670	455	28	7 x 5	239	23	30	Pa.
9	Coal	36	500	528	36	4	3,612	—56	75	W. Va.
10	Coal	36	500	500	36	4	753	—67	25	W. Va.
11	Coal	36	500	500	36	4	1,112	—4	40	W. Va.
12	Coal	36	765	675	42	7 x 5	604	126	150	Pa.
13	Stone	48	1,860	490	42	6	358	86	200	N. Y.
14	Ore	42	1,920	450	42	6	1,100	16	125	Ala.

shows a portion of the standard 36-in. belt conveyor used to determine belt action. For the usual installation, this accounts for more than 80% of the power requirements, practically all being in the carrying strand. Since it was not practical to study a loaded belt conveyor in the laboratory, the field test carriages in Fig. 8 and Fig. 9 were developed based on the suspended deck principle. Where belt tension is highest, loaded belt moving energy requirements are at a minimum. This is evident when loaded belt action is observed at different locations from feed point to discharge. Where tension is low, the loaded belt deflects or sags more than where tension is high. To a lesser degree, this same action takes place on the return strand. Thus, unlike the friction losses in the idlers, the power required to move the loaded belt is not constant per unit of conveyor length.

Fig. 10 presents some idea of the magnitude of the materials handling equipment required to load one of the belt conveyors tested. Fig. 11 shows how intermittent flow from a clamshell is converted into continuous flow by belt conveyor, at the same installation.

Design engineers have considered this non-linear distribution of power requirements in a belt conveyor, at least on a qualitative basis. Modern high tension conveyors are installed with variable idler spacings; distances being greater where tension is highest. It is significant that tons per hour moved per horsepower is at a high efficiency on these conveyors. Perhaps for other reasons, some handbook horsepower formulae use more favorable factors such as length, and consequently tension increases.

Conveyor Design Criteria

Many operational and maintenance problems associated with belt conveyors would disappear if a more precise initial design were possible. However, some apparent design deficiencies develop as a gradual operating process.

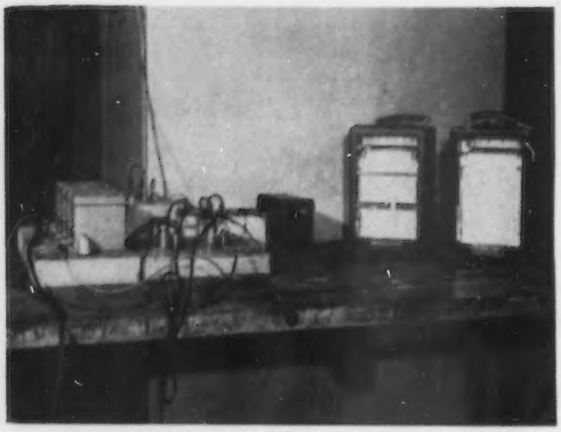


FIG. 5. Testing instruments included wattmeter, ammeter, indicating counters, automatic timer and battery pack.

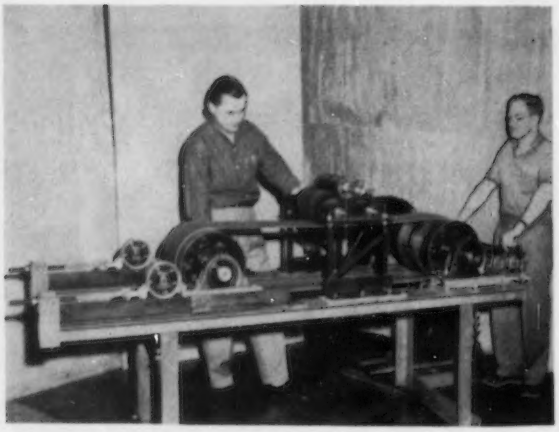


FIG. 6. Laboratory test stand for determining force required to turn idler rolls at different speeds.

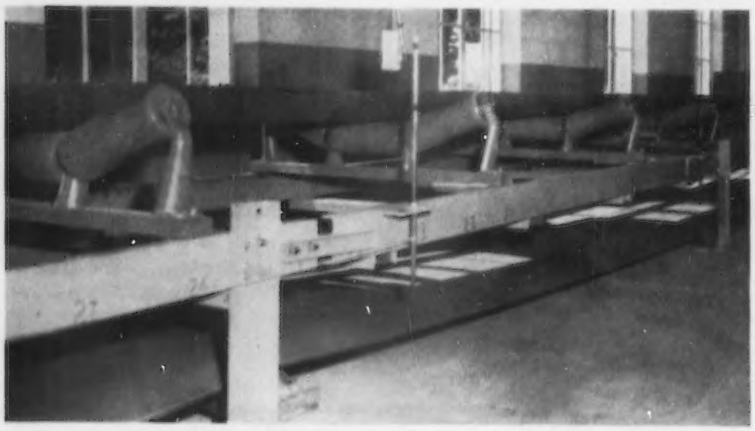


FIG. 7. Standard 36-in. conveyor with suspended deck to determine force required to move the belt over idlers.

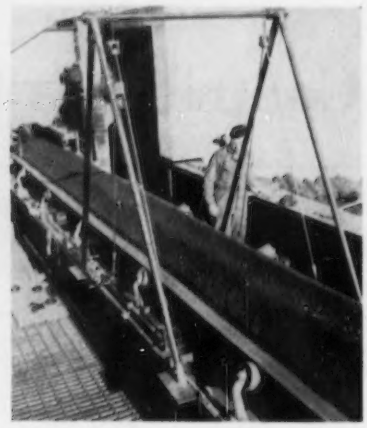


FIG. 8. Field test carriage to determine force required to move loaded belt.

These may involve idler rolls and assemblies, belt alignment and failures, drives and takeup adjustments. An example will illustrate in detail one of these common difficulties, and others are listed.

A 300-ft belt conveyor is used to convey coal horizontally, having been installed three years ago. The foot shaft is adjustable by a screw takeup maintaining the proper amount of slack side tension to insure drive pulley operation. When installed originally, the drive motor pulled about 80% of full load rating. This gradually increased until 6 months ago the motor failed. With a larger motor, the reducer failed. The answer is not in poor design but failure to appreciate a fundamental of conveyor operation. Total tension may come from the motor and takeup in varying amounts. When first installed, this ratio was four to one, but at the time of initial failure, was six to one. Thus, as the conveyor belt became older and more pliable, it stretched but did not necessarily lose strength. None of the difficulties outlined would have occurred if slack side tension at the takeup had been maintained.

At one of the field belt conveyors studied, material was being carried successfully at 600 tph although designed for 450. No change was made from the original design to obtain this higher capacity but belt speed at the crown of the drive pulley was not considered in the original installation. Due to the possibility of damaging idler roll seals, greasing was not done periodically at another test conveyor. If proper vents or fittings had been used, many bearing failures would have been avoided. At still another field installation, the grease fitting for a return idler was located less than 1-in. from a structural column. Even if this fitting could be reached, it is obvious that greasing will not be adequate. These are only a few of the specifications that should be checked carefully by the operator before the manufacturer installs the belt conveyors in mining and milling plants.

The logical method of designing a belt conveyor, or analyzing an existing installation for possible capacity increase, is by considering each component.

1. Friction losses in the rotating idler rolls are dependent on load, type bearing and speed to a small degree.

Fig. 12 indicates the relative turning force required for two styles of idlers.

2. Force required to move the return belt varies with tension, type of belt and idler spacing. Fig. 13 is developed from laboratory data and indicates magnitude of empty belt losses.

3. Carrying strand resistance is influenced by tension, belt load section, idler spacing and tilt. Fig. 14 shows isotention lines for variable load sections as determined from field test carriage data.

The sum of these three components

expressed in pounds is a measure of the effective tension required. On relatively short conveyors, or units with high tension bend pulleys, the terminal losses must be added. Also, changes in belt slope affect tension and must be added or subtracted.

It is obvious that knowledge of tension at all locations in a belt conveyor is imperative if an accurate analysis is to be completed. Unfortunately the tension cannot be measured at more than one location. However, a reasonably accurate determination is possible by correlation with belt sag or deflection. If the belt acted as a suspended cable, the parabolic formula could be used directly. Since carcass construction causes the belt to act somewhat as an indeterminate structure, actual is less than calculated sag by a certain per cent. For the most common type of belt conveyor, the actual sag of the return strand is about 10% less than calculated. This relationship can be used to estimate belt tension.

Fig. 15 is a graphical representation of the relative changes in belt tension around a belt conveyor. The counterweighted takeup is located at the conveyor discharge and accounts for slack side tension and tension in the return strand. Moving with the belt travel along the return strand, tension increases from the takeup bend pulley to the tail. The belt at this tension is carried around the tail pulley, plus a small amount due to terminal friction. At the feeding point, the tension begins to increase rapidly due to power required to move the loaded belt over the troughing-idlers. Although shown as a straight line, the rate of tension change gradually becomes less in the direction of belt travel. Belt tension is at a maximum at the conveyor discharge and is equal to the effective output to the drive shaft and slack side tension due to the counterweight. A clear understanding of these principles of tension distribution is essential to belt conveyor design and operation.

Conclusions

Although results of this research project have provided a more substantial basis for belt conveyor design, successful application is dependent upon the judgment of the analyst. It must be decided if a certain spacing, idler roll, or belt construction is best for the conditions expected. Not only is initial design important, but operating conveyors must be analyzed before changes are contemplated.

Investigations to date have been rewarding but many areas still require further study if the handling of mined materials with belt conveyors is to improve in accordance with needs.

1. Starting of conveyors is a major problem and a study of drives is necessary for a satisfactory solution.

2. Material transfer and feeding should be studied to improve load section, belt wear and power loss.

3. Vertical curves at slope changes are arcs of radius circles, whereas the parabolic or catenary may provide

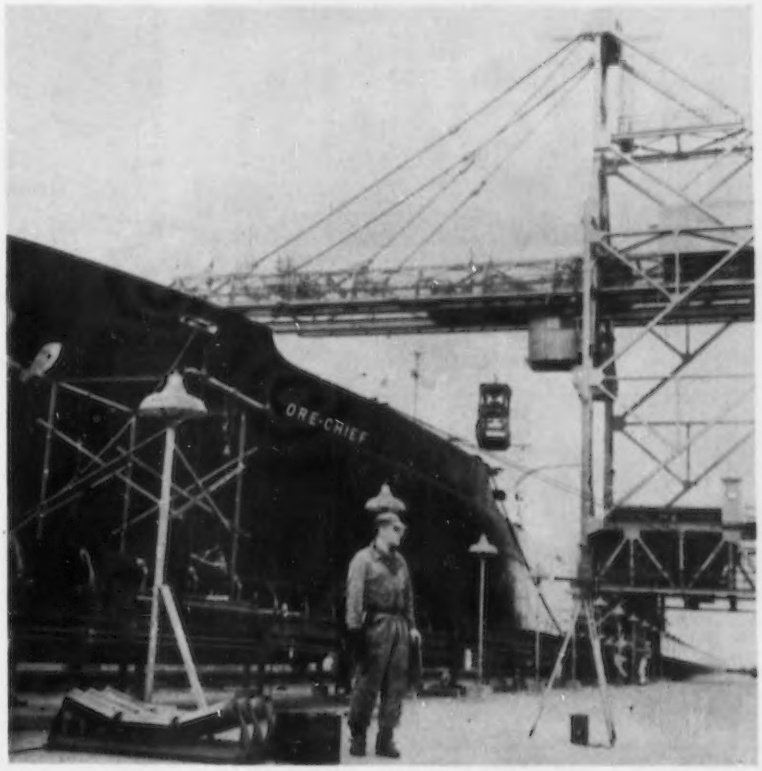


FIG. 9. Second model of portable field test carriage used to measure force required to move loaded belt.

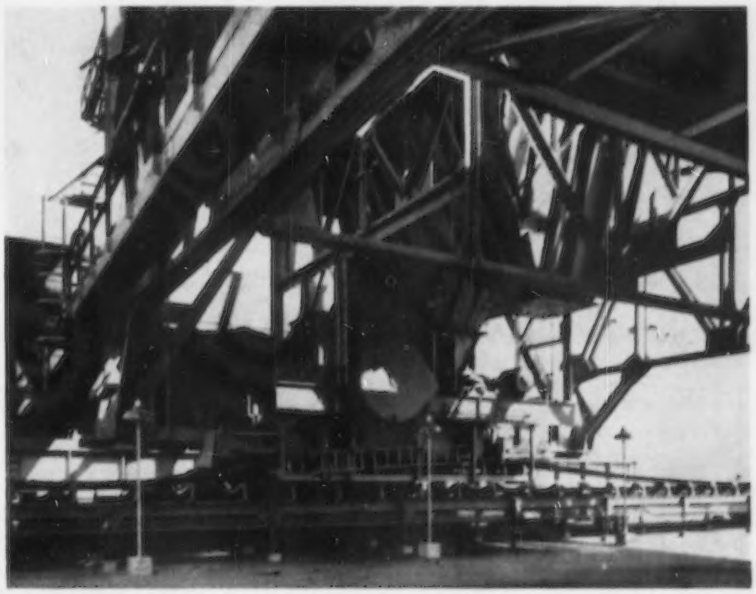


FIG. 10. Loading arrangement for mined materials. Tests were made on this belt conveyor installation.

FIG. 11. Intermittent feed from bucket is converted into steady feed on belt conveyor at this ore bridge.

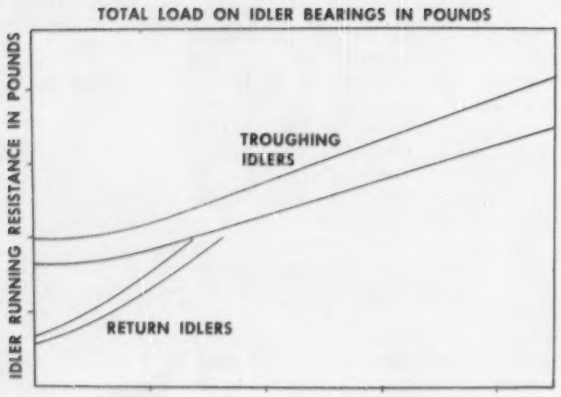


FIG. 12. Variation in force required to turn two styles of idlers for different magnitudes of bearing load.

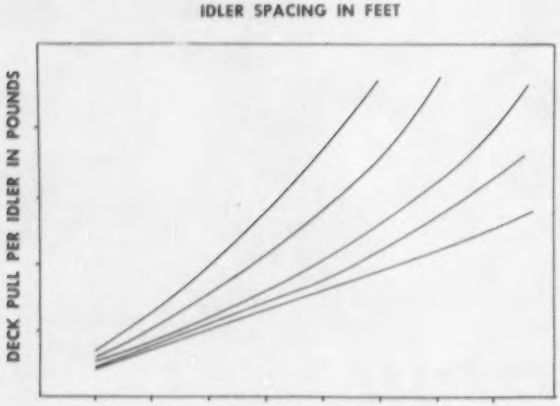


FIG. 13. Force required to move belt over idlers for variable spacing as determined in the laboratory.

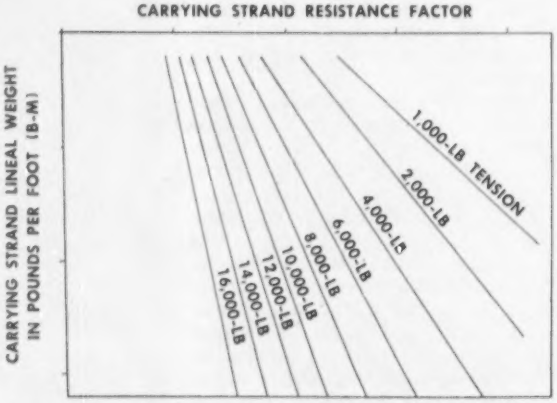


FIG. 14. Force required to move loaded belt over idlers for variable loads as determined in the laboratory.

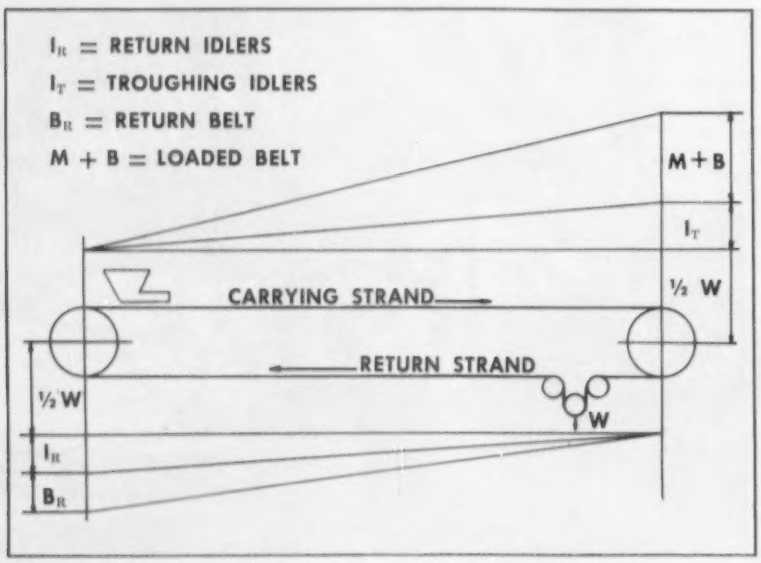


FIG. 15. Distribution of tension around a loaded horizontal belt conveyor. Counterweight is near the discharge.

better operation at places where belt slopes change.

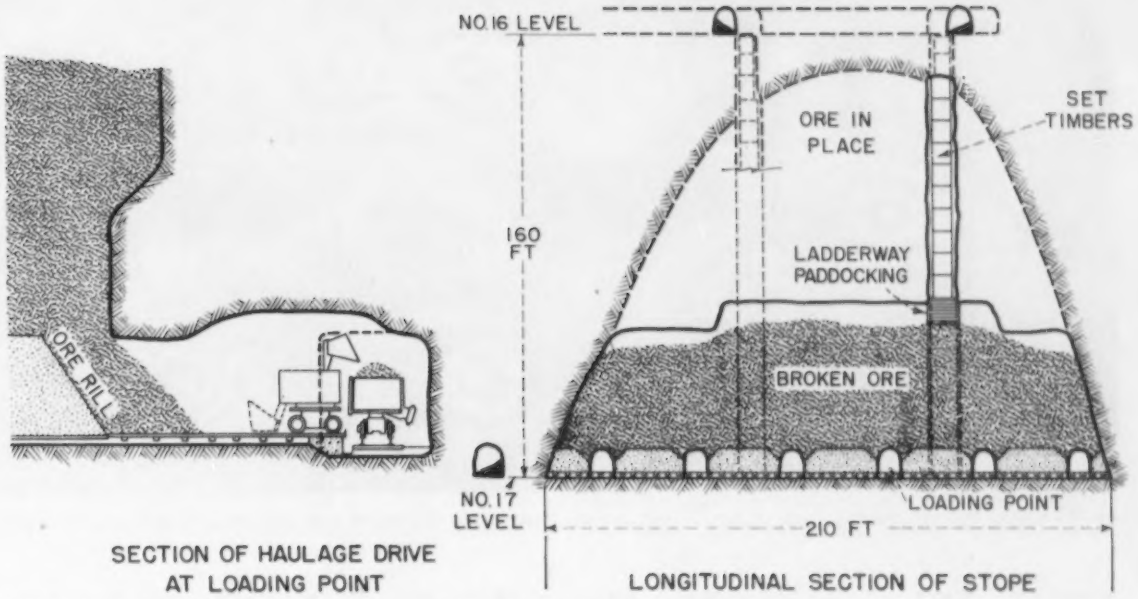
4. Decline conveyors, because of functional peculiarities, seldom operate as originally designed, causing much delay time.

5. The actual effect of terminal friction is unknown, preventing an efficient conveyor design.

6. Drive mechanical power transmission losses in belt conveyor systems are important and should be studied.

7. Little is known about the load turbulence effect of material size, moisture and type of mined material.

8. Similar to other materials handling devices, belt conveyors pass through a change in efficiency, expressed in tons per hour per horsepower, which can be determined through research and observation.



LOADING with mucking machine and using mill tailings for sill are part of new scheme on Broken Hill Lode in Australia.

Zinc Corp. Tries Shrinkage Stoping

WATER SPRAYS are used in drawpoints at ends of short loading drifts which turn off at right angles to haulage crosscut.

A TAILINGS FILL SILL and mucking machine loading scheme has given good results for Zinc Corp., Ltd., of Australia in shrinkage stoping on the Broken Hill Lode.

Normally, cut and fill methods are used in the district because the rich ore has weak walls. But a block of ore at Zinc Corp., estimated to contain 1.3-million tons, was too low grade to be mined by the usual methods with normal costs. Fortunately the walls of this block were fairly strong and engineers could work out a plan to develop two lower cost shrinkage stopes above the No. 17 level.

One part of the scheme calls for loading the mine cars with overcast mucking machines. This eliminates the expense of chutes and of raise work for the ore passes. It also reduces the need for height and frees that ore for extraction.

Another part of the scheme completely eliminates tying up ore to gain gravity flow to the loading point. This is done by silling out the stope at haulage elevation and then filling the bottom 9 ft with hydraulically placed mill tailings.

A third part of the scheme has the short loading openings at right angles to a haulage crosscut with the mucking machine rails 11 in. above the haulage rails. This permits running the machine directly onto a mobile turntable and then moving it to another loading point with a minimum of time and effort. A block and tackle set-up in the crosscut is used to take loader off mobile turntable if necessary.

The two stopes laid out are about 200 ft long on the sill. The ore-rock contact arches over about 150 ft above the No. 17 level so long section of stope is semi-circular. The stopes are 33 ft wide and separated by a 33-ft wide pillar. Haulage crosscut runs in pillar.

First step in developing the most southerly stope was starting two access winzes from drives in rock on No. 16 level—160 ft above No. 17 level. Then on No. 17, a crosscut was driven full length on centerline of stope. After back and sides were stripped 25 ft wide, and 16 ft high, raises were cut up to winze bottoms from short drifts into the pillar. Stope was then mucked out and filled about 9 ft high with mill tailings. Finally stoping started.

Meanwhile, from haulage (loading) crosscut in pillar, drawpoints were excavated. The ends were left solid until after fill had set and stoping started. Then they were broken through into stope and ore was withdrawn as needed to maintain headroom for mining.

Mining proceeds from one winze, taking one slice for full length of stope. About one-third of ore broken on each slice must be withdrawn to give working room. Good fragmentation is essential to maintain free flow from draw point.

The winzes have ladder way and supply hoist. They will remain open for life of stope and will be used during later extraction of the pillar, giving access and ventilation.

PROCESSING volcanic sulphur high in the Chilean Andes, miners fight against the cold, and the high milling costs; trying

Five Ways to Refine Volcanic Sulphur

FERNANDO BENITEZ

VOLCANIC SULPHUR IS NO SNAP. It's not as simple as pouring superheated water down a hole into a salt-dome deposit. On the porous, shattered volcanic deposits the Frasch process will not work. The Ruiz process, common to Italian sulphur-limestone, won't work. Here in Chile, we have tried many methods; all of them expensive, none of them entirely satisfactory.

We have to have a better method. Here's what we've tried and the results of those trials. Check them over.

Mr. Benitez is a Consulting Engineer from Santiago, Chile.

The best method combines flotation and autoclaving of the concentrate (80-90% S). Even this method is handicapped by the very high altitude, the long haul for fuel and finished product, as compared to salt-dome deposits that have cheap transportation and natural gas at hand.

1. Flotation and Autoclaving

We started the first flotation sulphur plant in Chile at a small mill built by Mining Credit Bank at Amincha in 1937. Amincha is near the Ollagüe rail depot, at 13,000-ft altitude. Ollagüe is the last stop on the Chilean side of the Antofagasta-La Paz railroad. Earlier, sulphur had been floated in the U. S. at Humboldt, Nev., and at Sulphurdale, Utah.

Sulphur does not need promoters and can be made to float with simple and cheap reagents. Combination most used in Chile was coal-gas creosote and pine oil. Now, it's kerosene and Dowfroth 250. American Cyanamid's Frother 77 and alcohols also will give good results. When good recovery cannot be had by these selective frothers alone, a small amount of kerosene helps.

With two- or three-step cleaning and recleaning, an 85% concentrate at 85% recovery is possible. Denver and Agitair cells are most popular, but Forresters have been used. Residues from the steam autoclaves (below) float easier than raw ore. Sometimes the autoclave residue is simply screened and the oversize floated at a coarse mesh, with undersize being discarded. Wear on the cells is severe under these conditions.

Grinding varies with the ore, rather fine for most cases. On the autoclave residue, flotation can be carried out at a coarser mesh than on ore (because the finely disseminated sulphur in the ore has coalesced into coarse globules in the autoclave).

Concentrates are treated in stationary autoclaves. They are favored over rotaries. Autoclaves are built mostly of cast iron or meehenite, although cast steel has been used. Cast iron is far more resistant to molten sulphur and steam.

PRIMITIVE mining methods prevail at Aucanquilcha volcano mine, 20,000 ft high.

many ways to produce the nonmetallic. **POLAN** is one of the many deposits that spread south from Arica as far as Chillan.

Autoclaves have a cylindrical central part and an upper and lower 45-deg cone. The autoclave is charged through a removable screwed-on head that forms the top of the truncated cone. Heads are 8- to 10-in. diameter, depending on the size of the retort. Steam and/or superheated water enter through a pipe and valve located near the center of the retort. There is a steam outlet at the top.

A hinged door just above the lower cone opens to discharge the residue. Inside the vessel, and just below the lower door, a cast iron grate is inclined at 30 deg with the horizontal. The ore rests on this grate. The bottom cone is steam-jacketed to keep molten sulphur, that falls through the grate, from freezing in the bottom cone. This molten sulphur can be removed through a very simple plug or cone valve.

Autoclave capacity varies from 1.2 to 10 tons ore or concentrate; 2.5 being the size most favored today after the failure of the 10-ton autoclave at the Amincha plant (see below).

When charged, steam is admitted until pressure builds up to 50 psi, sufficient to raise the ore temperature above sulphur's melting point (119 deg C). This is well below sulphur's maximum viscosity point (200 deg C). Pressure at 50 psi is maintained during the whole batch cycle.

A batch lasts an average of about an hour and part of the molten sulphur trickles through the ore and through the grate below. Superheated water is always present because some of the steam is bound to condense due to the low ore temperature at 13,000 ft; or because superheated water is purposely injected to improve heat transfer. Sulphur has a very low thermal conductivity and this water helps us melt it.

When the melting time is complete, the molten sulphur in the bottom cone is tapped. The steam release valve is opened until the pressure drops to 5 to 7 lb. Then the bottom door is unhinged suddenly—the remaining steam pressure discharges the crushed residue with a rather deafening explosion in a cloud of steam and flying bits of residue.

Autoclave recovery is very low, since the gangue holds a large portion of the original sulphur in the form of small globules. Residues assay 30 to 40% S, depending on the ore.

Tests conducted by Professor Krassa and his assistant, Señor Silbermann, at the University of Chile, show that adding wetting agents to the injected water reduces the amount of sulphur retained by the gangue.

As a rule, ore going to the retort is not crushed, but sledged small enough to pass through the top door. A thin layer of coarse ore is placed on the grate when treating flotation concentrate, so that fines do not fall into molten sulphur below.

Many boiler types have been used to produce steam. Most of these steam generators have been bought second hand from old nitrate plants and few have superheaters. Fuel may be "yareta", a kind of moss common to the high Andes, coal or fuel oil. Installed boiler horsepower per ton-day brimstone averages 6. Fuel consumption is about 300 lb per ton sulphur. Water use reaches 1,800 lb per ton sulphur.

Brimstone, 99.5% pure, is sold at about 25,000 pesos a metric ton, which works out to about $50 per ton (using free exchange rate of 500 pesos per U. S. $1).

2. Rotary Autoclaving

Rotary autoclaves were introduced into Chile from Italy at the Codocedo plant (Copiapo) in 1937. These units have been made of both cast iron and steel; but if steel is used, the interior of the vessel is protected with concrete to prevent sulphur corrosion. They are cylindrical in shape, up to 2 meters in diameter and 6 meters long, built in sections. They rotate at about 7 rpm and are inclined at 7 deg toward the discharge end.

Feed, a 50-50 mixture of 40-mesh ore and water, enters at the upper end. Steam pressure of 70 lb is held during the melting cycle. Under conditions in the autoclave (gentle agitation of the ore and water) sulphur coalesces into globules and separates from gangue. It then finds its way to lower end of vessel where it is tapped through a valve.

Pulp from the vessel is screened at ⅛-in., where some of the globules are retained.

Brimstone obtained is 99.5% S. Plus ⅛ globules run 95 to 56% S, have to be retreated. Rotary autoclaves have been used at Codocedo, Amincha and Villa Industrial plants. After the two vessels at Amincha burst because of faulty castings, they lost favor even though recovery is better than in stationary autoclaves.

3. Distilling Flowers

Distillation to yield flowers of sulphur is little used in Chile today. In the process, sulphur-bearing ore is charged to a coal-fired cast iron retort and distilled at 444.6 deg C. Volatile sulphur passes to a large condenser (up to 300 cu m) where most of the

VOLCANIC SULPHUR, like Santa Rosa, above, can't compete with Frasch domes.

MINING is on very edge of volcanoes.

sulphur condenses as flowers of sulphur.

If the condenser temperature is low, liquid sulphur phase is bypassed; but if the temperature is above 114 deg C, sulphur deposits as brimstone. This happens in small chambers. But, no matter how large the chamber, some brimstone is always obtained where gas enters the chamber, because temperature is still too high at that point.

Distillation capacity is small and recovery is far less than residue assays shows. Product market is not large. Flowers of sulphur must compete with Raymond Mill ground brimstone in the fungicide and insecticide industry.

4. Agglomerating with Acid

In 1942, Señor Mauricio Hochschild tried the agglomerating process at a plant in Antofagasta. The process was developed by A. B. Menefee and succeeded in treating about 1,500 metric tons of sulphur flotation concentrate purchased from Amincha plant of the Mining Credit Bank.

Dried flotation concentrate (75% S), ground to minus ⅛-in., if heated above the melting point of the metalloid and slowly agitated in an open vessel with right amount of sulphuric acid, will coalesce the sulphur and agglomerate the gangue. Pellets of gangue can be filtered from the molten sulphur. Sulphuric acid wets the gangue, collects the bitumen and allows the sulphur to collect in the bottom of the vessel. A good grade and color brimstone can be made.

In the autoclave process, if sulphur is contaminated with iron sulphide or sulphate, the brimstone is bright green, even though the sulphur may run 99.5% S. Such an objectionable color is not obtained with the agglomerating process.

The Hochschild pilot plant at Antofagasta had a capacity of 17 tpd. The melting tank holds 4 metric tons concentrate, which is heated to 135 deg C by 75-lb steam in steam coils within the tank. Concentrate is steadily fed to the tank and the heated mass slowly agitated with a mechanical stirrer running at 415 rpm.

From melting tank, pulp passes to two, one-ton batch tanks, fitted with steam coils and agitators and held at 135 deg C.

At this point, 91 to 99% sulphuric acid is added to the heated pulp and agitated for about an hour to agglomerate the gangue. These pellets float on the molten sulphur, but no attempt is made to skim them off the top.

The mixture is transferred through pipes to one of two steam-heated filters, whose bottom has a double steel screen with 3mm openings. Glass wool separates the two screens. Filtered sulphur goes through steam-jacketed lines to casting blocks, while the gangue is discharged from the filter by tilting the screens onto a small bin. Cars carry the gangue from here to the dump.

It was found that concentrate or ore carrying 65% sulphur was minimum feed grade for this process. Lower grades produced a heavy, viscous mass that did not lend itself to agitation. Amincha's concentrates run about 85% S; so minimum 65% S is not difficult to maintain here.

Concentrate treatment cost by agglomeration is about $15 a ton brimstone (1942). This is high, since mining, flotation and general expenses must be added.

Sulphuric acid is the highest cost item; as the process uses 240 lb acid per ton brimstone. Acid cost in Chile is high. Coal use for steam was 330 lb per ton brimstone.

5. Solvent Extraction

Both the Italians on Sicily, in a pilot plant under the direction of the Italian engineer Gemmellero, and the Germans, have used carbon disulphide as an extracting solvent for sulphur. At 40 deg C and 12 psi, CS_2 dissolves its weight in sulphur. At 0 deg C, the disulphide holds only 18 gm sulphur per 100 gm solution.

At the present time there is one plant using the CS_2 process at the Polan deposit near San Pedro de Atacama, Antofagasta Province. Results so far have not been very satisfactory and costs are higher than for flotation-autoclaving method. This plant is of German design.

Another solvent extraction method uses calcium chloride. This process was tried at Inyo, Calif. about 1935, but results were not satisfactory and the plant was later destroyed by fire. Magnesium or zinc chloride could be used. Salts must be inexpensive, as there is appreciable loss in the residue. Brimstone by this process is 97% S.

This list of attempts to win sulphur from the edges of volcanoes in the Andes shows clearly that the solution is not easy. Weighed down by mining costs at high, cold altitudes, it is very difficult for volcanic sulphur to compete with Frasch material. We must look at Andean sulphur as a reserve for the future when salt-dome sulphur is no more—unless we can come up with a sure-fire, low cost method.

Editors' Note: The Chileans have been pretty energetic on this problem and would welcome some new ideas. We'd like to suggest burning-in-place to make SO_2 and H_2SO_4.

Origin of Andes Sulphur Deposits

CHILE SULPHUR DEPOSITS are all found in the Cordillera or Andes Range, mostly near peaks of extinct volcanoes. Some commercial deposits are close to active volcanoes as well. This long chain of deposits extends to North and Northeast as far as southern Peru and Bolivia and to the East in Argentine.

In Chile, this sulphur-bearing belt is almost continuous from Arica, near Peruvian border, to Chillan in the South. Some of the volcanoes containing deposits show strong activity, as at Ollagüe, whose beautiful, strong smoke column can be seen ascending straight as a pole on calm clear days. Chillan, Villarica and Calbuco are also active.

In North America, most of the sulphur deposits are domes in Texas, Louisiana and northern Mexico, but a few volcanic deposits are known, particularly at Sulphurdale and Purgatory, Utah; Inyo County, Calif.; and at Humboldt, Nev.

Some 70 sulphur deposits exist in Chile. Reserves have been estimated at 30- to 60-million tons, with the total figure near 60-million.

The orebodies in or near these volcanoes are bedded. Richest sulphur occurs in lenses and occasionally as gash veins. Bleached, whitish rocks, a result of volcanic activity and sulphurous gases which leached out ferro-magnesium elements, can be seen from far away in the clear, thin air of the high Cordillera.

There is no question as to their volcanic origin. Eruptions cracked the rocks near the volcanoes, forming a coarse irregular mesh of fissures. Sulphurous gases found an outlet to the surface. Most of these gases were H_2S and SO_2. As this mixture got nearer the surface, it began to lose temperature and pressure and sulphur was deposited according to this formula:

$$2H_2S + O_2 \rightarrow 2H_2O + 2S$$
$$2SO_2 + 4H_2S \rightarrow 3S_2 + 4H_2O$$

According to some geologists who have made detailed studies of these deposits, oxidation of H_2S is probably the main source of the sulphur. Plenty of oxygen would have been available due to the deep fissuring and cracking of the surface.

Most of the surrounding rocks were severely shattered by the eruptions. Terrain was covered by loose volcanic ash. When steam, H_2S and SO_2 began to escape through the fissures and volcanic ash, it heated up the rock and melted the sulphur produced. Sulphur and broken rock and ash formed a kind of breccia; with the sulphur as matrix.

This ore deposition is in sharp contrast with salt-dome deposits in North America and porous-limestone deposits in Sicily and Italy. Here the Frasch process cannot be used, nor can the calcarone or Ruiz method, common to Italian ores be used.

The Ruiz method, where part of the sulphur is burnt to melt and free the rest, has been tried without success here in Chile. Even when we had Italian engineers come over and build the calcarones it would not work.

Sulphur-bearing beds vary from a few feet to as much as a 100-ft thick. In some deposits, ore beds outcrop. In others, beds are covered by a barren cap or low grade beds up to 50-ft thick. This cap has no commercial value. It is sometimes soft enough to bulldoze aside.

Commercial beds here run 35 to 60% sulphur. Rich veins of practically pure sulphur are found but these veins are neither very long or very deep. In or near volcanic cones, beds outcrop or are covered by a thin, barren or low-grade cap. Commercial beds are always harder than overburden, due to cementing effect of sulphur.

Andesite, dacites and rhyolite are associated rocks. Rocks in or near the deposits have been greatly altered (by the sulphur-bearing gases) to rocks rich in kaolin. The feldspar has been altered and all the ferromagnesium minerals have been leached away. The sulphur has been deposited around siliceous rocks, rich in calcedony. There are also breccias within the beds.

Two types of ore are found: one is canary yellow in color, more or less porous and is earthy; while the other is black to chocolate, higher grade than the yellow and called "negrillo" for its bituminous color and content.

Volcanic ash, tuff, pumice, clay and gypsum makeup gangue minerals. Ores with much clay and gypsum are difficult to treat. Secondary products in the beds are gypsum, alum, ferric sulphate and clay.

These sulphur beds are mined by methods that are primitive to say the least. Efficiency is low due to lack of mechanization, the very high altitude, very low temperature and the strong winds of the high Andes.

Major Sulphur Deposits in Chile*

TARAPACA PROVINCE: Tacora, Chupiquina, Aguas Calientes, Caracarani, Tahapaca, Colpitas, Larancagua, Jaruma, Inquillane, Lexone, Payachatas, Aroma, Huallatire, Caporata, Puquintica, Anocarire, Arentica, Choquenunta, Chiguana, Pumite, Huaina-Potosi, Sillajuaya, Irruputunco, Victoria and San Manuel.

ANTOFAGASTA PROVINCE: Chutinza, Ocana, Puquios, Olca, La Flecha de El Olca, Polan, Aucanquilcha, Chalhuire, Ollagüe, Polapi, Ascotan, Colana, Cabana, Putana, Laskar, Socompa, Lastarria and Tropezon del Chaco.

ATACAMA PROVINCE: Gorbea, Los Gemelos, Salar de Azufre, Juan de la Vega, Piedra Parada, Pedernales, Sierra de Tres Puntas, La Coipa, Codocedo, Volcan Copiapo, Sierra del Negro Francisco, Mantos Atacama and Huasco.

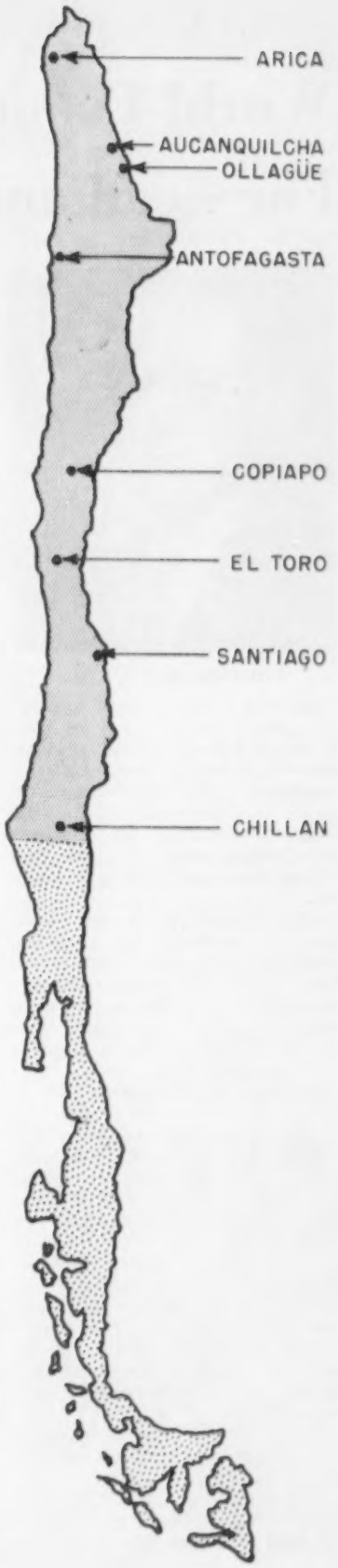
COQUIMBO PROVINCE: El Toro.

COCHAQUA PROVINCE: Tinguiririca.

TALCA PROVINCE: Laguna del Maule.

NUBLE PROVINCE: Chillan.

* From *Recursos Azufreros de Chile*, by Tomas Villa. Boletin de Minas y Petroleo, Vol. VIII. No. 82, May 1938.



World Economy in 1956—A Challenge For Lead and Zinc Men and Industries

PHILLIPS: Frankly, a plea

CLARIFICATION and discussion of the problems facing the lead and zinc industries was the basic theme of the annual joint meetings of the Lead Industries Association and American Zinc Institute, attended by more than 400 members April 23-25 in St. Louis, Mo.

The three-day session also investigated the marketing, consumption, production and competition in the field, hearing from leading spokesmen for domestic and foreign producers, galvanizers, pigment producers, refiners, Government officials, scientists and consumers.

Chairmen of the sessions were as follows: F. S. Mulock, president of U. S. Smelting, Refining & Mining Co. and president of the Zinc Institute, joint session AZI and Galvanizers Committee; R. G. Kenly, vice president, New Jersey Zinc Co. and vice president AZI, afternoon session of the joint session; Andrew Fletcher, president, St. Joseph Lead Co. and president, Lead Industries Association, joint session LIA and AZI; Joseph A. Martino, president, National Lead Co. and vice president, LIA, association meeting and business sessions, committee reports; J. A. Costello, vice president, Ethyl Corp. and executive committee member of LIA, session on uses and outlook of lead.

Spokesmen for the organizations called the annual joint meeting one of the most successful in several years. Attendance at all sessions was large and discussion vigorous. Mr. Mulock and Mr. Fletcher were re-elected presidents of the two organizations, as were their respective junior officers.

A plea for greater dissemination of research information was made at the joint session of the two groups by Dr. Albert J. Phillips, vice president and director of research, American Smelting & Refining Co.

"The potential user of a material today is the engineer who is designing an article of commerce or a component," Dr. Phillips said. "He is hunting for certain specific combinations of properties and wants to find the material that will supply these properties in his finished article or component at the lowest cost." Citing the development of volume uses for titanium in paint pigments and lead in tetraethyl-lead, the AS&R vice president pointed out that both had come as a result of work on the part of the eventual consumer, not that of the raw material producer. While noting that the raw materials industry could take credit for vigorous research and promotion of zinc-aluminum alloy against an unfavorable beginning, Dr. Phillips said . . ."What all this leads to is a plea for more and more data on our metals, their alloys and their compounds.

"I daresay," he said, "that more fundamental data have been accumulated on titanium in the last ten years than have been accumulated on lead and zinc combined."

LeFEVRE: U. S. supplies a half

VUILLEQUEZ: Wanted, zinc markets

Specifically the speaker cited the need for basic research information on lead as a super conductor, the possible development of new organic compounds of lead and zinc which might have a market potential similar to that of tetraethyl-lead, the investigation of the potentialities inherent in the high vapor pressure of zinc and the expanding possibilities for the use of lead in radiation shielding at atomic energy installations.

"The stockpiling program, as inaugurated by the Government in 1954 in place of relief to the domestic zinc mining industry under the Escape Clause of the Tariff Act, apparently has not accomplished the maintenance of an adequate industry mobilization base," according to G. H. LeFevre, vice president, U. S. Smelting, Refining & Mining Co. Mr. LeFevre made the observation in the course of significant talk entitled "Zinc Market Developments in the U. S. in 1955."

Noting that 1955 was a record year in several respects, the vice president and sales manager observed that production and consumption of slab zinc each set an all time high of slightly more than 1-million tons. Total imports reached 687,000 tons, he pointed out, or 92% of the peak year. Mine production was 504,000, 6% above 1954, the lowest production year since

the depression years of the early 1930's in the United States.

"In 1951 and 1952, the two highest production years since 1946, mine production totaled about 681,000 and 666,000 tons, 72% and 79% respectively, of these years' consumption requirements," LeFevre noted, "but in 1953 there was a heavy inflow of concentrates and metal of foreign origin to this country—an oversupply—and the price broke sharply, necessitating the closing of many mines. So heavy was this inflow of foreign zinc that in 1954, domestic mine production was sufficient to take care of only 53% of domestic consumption." In 1955, the speaker said, production was only sufficient to take care of 47% of domestic consumption. "In brief, slab zinc consumption in the U. S. has increased steadily in the last 10 years but due to the unrestricted flow of foreign zinc into this country, commencing with 1953, domestic mine production has been curtailed to the extent that from 1946-1952 it came within a range of 76% to 80% of consumption requirements, while in the period 1953-1955 . . . it was sufficient to take care of only approximately 50% of the consumption requirements."

Production of slab zinc has been closely in step with demand, said LeFevre. In 1955, smelter slab zinc output totaled 1,031,000 tons. The 1955 average was 953,000 tons. He credited the steady rise in slab zinc consumption to increased use of zinc in die castings and from the requirements of the continuous galvanizing process. To a lesser extent, he said, increased use in the brass industry has bolstered the climb.

"Die casting industry requirements are now in total amount second only to the galvanizing requirements . . ." he said. Latter consumed 440,000 tons during 1955. At year end, 26 galvanizing lines were in operation, two under construction and 10 being planned.

ROMNEY: Help from all parties

MARTINO: Business session, reports

The brass industry used 102,000 tons in 1955, a figure below the 1951-1955 average of 146,000 tons. The speaker traced this difference to the large use of shell casings left over from World War II, which found a ready market in the brass industry in the early post-war years.

"We may have . . . a new and powerful influence on international metal and mineral markets which could prove of material benefit to segments of our domestic mineral economy for some time to come" in the action of barter agreements for foreign metals and U. S. agricultural surplus, said Felix A. Wormser, Assistant Secretary of the Interior.

The Government, said Wormser, is simply "embarking upon a program of acquiring critical and strategic materials over and above those needed for military stockpiling and these acquisitions are to be isolated from commercial markets in the same manner as the military stockpile. They will be 'frozen.'"

The Assistant Secretary, discussing total accumulations, said, "it is easy to see that, theoretically, several hundred-million dollars' worth of metals and minerals might be obtained through these programs. The President, of course, will have the final determination as to the size of the supplemental stockpiles that may be acquired, but the goals in any event are bound to be high. . . ."

In suggesting industry support of the Organization for Trade Cooperation, Wormser said, "OTC is an opportunity to encourage other nations to dispense with government enterprises, rid themselves of cartels and lift the heavy hand of bureaucratic controls.

"It is an opportunity to sell capitalism." OTC, he said, would not alter the existing authority of governments to enter into or refuse to enter into commodity agreements.

Supply and demand will continue at high levels in 1956, according to Jean Vuillequez, vice president of American Metals Co., who made the forecast during a discussion of "World Lead and Zinc Supplies and Requirements."

The Government's stockpiling program, he said, will continue to act as a market stabilizer. "It appears to me," the official said, "that over the next 10 years an increase of 20% to 25% in the Free World's use of lead is necessary and zinc must find markets so as to increase its use by at least 35%."

Vuillequez indicated that he does not think a reduction in the use of the metals need occur as a result of curtailment of domestic automobile production. He noted that this year's models are using more zinc than ever before in die castings, and that consumption of lead is not so much tied to auto production as to consumption of battery lead and gasoline by cars on the highway.

To make "any kind of a recovery" in the near future, the lead and zinc industries need help from all interested parties, said Miles P. Romney, manager of the Utah Mining Association.

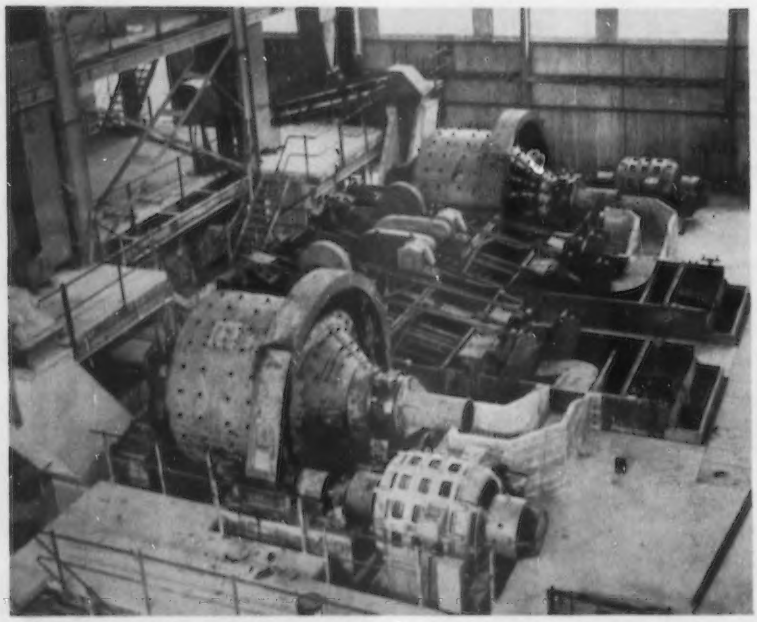
Romney noted that mine production in the U. S. has suffered from the continuing imports of lead and zinc; the approaching end of the stockpile program; and the increasing deficit in the mine operator's income resulting from increased cost of production and the present and long-term average low price of the metals produced.

"The time of decision," Romney said, "depends on the level of general economic activity and on the life length of the stockpile cushion."

WORMSER: For OTC, support

CONCENTRATOR and filter plant dominate the landscape around the mine. 1,500-ton capacity ore pile is in foreground, ore storage pens in right background. First ore was hoisted in October 1955; has been stockpiled for concentrator opening.

Chibuluma Starts Moving Concentrates



CLOSED CIRCUIT takes concentrate from ball mills (10 ft by 72 in.) through rake classifiers. Pulp then travels to flotation section, is later filtered nearby.

Contractors and Equipment

Equipment in use at Chibuluma copper and cobalt mine, and contractors in charge of construction include the following:

Jaw crushers—Fraser & Chalmers
Crushers—Nordberg Symons gyratories
Flotation machines—Denver Equipment Co.
Pumps—Wilfley (E. L. Bateman)
Classifiers and filters—Dorr-Oliver Co. (E. L. Bateman)
Conveyors—Robins Conveyors
Electric motors—Crompton Parkinson
Reduction gears—Wiseman
Motor control gear—Allen West
Switchgear—Reyroll, Ferguson Paling, English Electric
Hoists—Robery, Metro Vick

Works erection and plant installation—Wright Boag & Head Wrightson
Plant installations—Fraser & Chalmers
Electric installations—D. Messerer
Civil works—O. Grimeker, Roberts Construction
Builders—Tatalias & Co.

COPPERBELT mines blanket Rhodesia. Rhodesian Selection Trust, Anglo-American Corp. extract vast metal tonnages.

CONSTRUCTION of No. 1 belt conveyor (left) was nearly completed when this picture of Norrie Shaft headframe was taken.

PRODUCTION of copper and cobalt concentrates began Saturday, May 5 at the new Chibuluma mine in Northern Rhodesia, owned by Rhodesian Selection Trust. Chibuluma is the first new mine to come into production on the Copperbelt since before World War II.

Chibuluma is situated nine miles west of Kitwe (headquarters of the Nkana Copper Mine).

Capital costs of developing and equipping the mine total some $17-million (£6-million). Of the sum, approximately $14-million has been advanced by the U. S. General Services Administration, the loan to be repaid in metal.

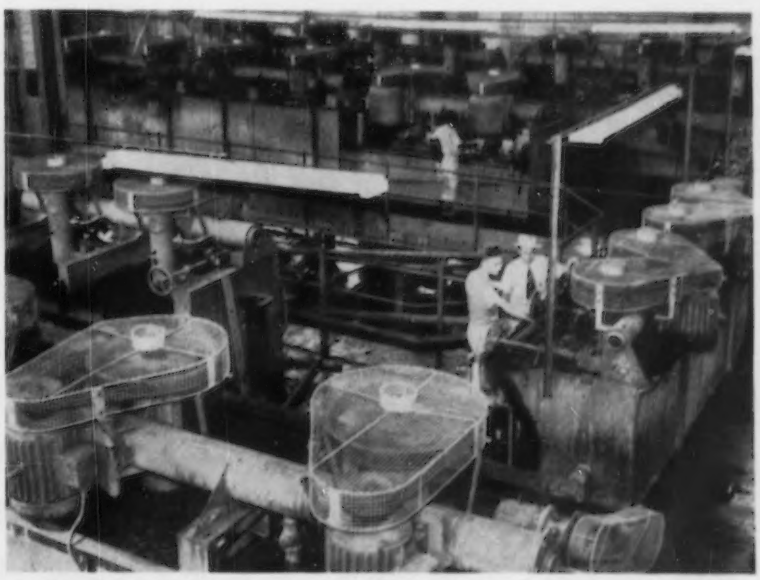
Ore reserves at the new property are estimated at 7.3-million tons at an average grade of 5.23% Cu and 0.25% Co. Mine is currently hoisting ore at an annual rate of 480,000 tons copper and 500,000 lb cobalt. First hoisting took place in October 1955; ore was stockpiled until last month.

Construction of the Chibuluma concentrator began in July 1954. Design based on small-scale test work and current metallurgical practices preceded the construction in a search for a satisfactory method for separating the ores.

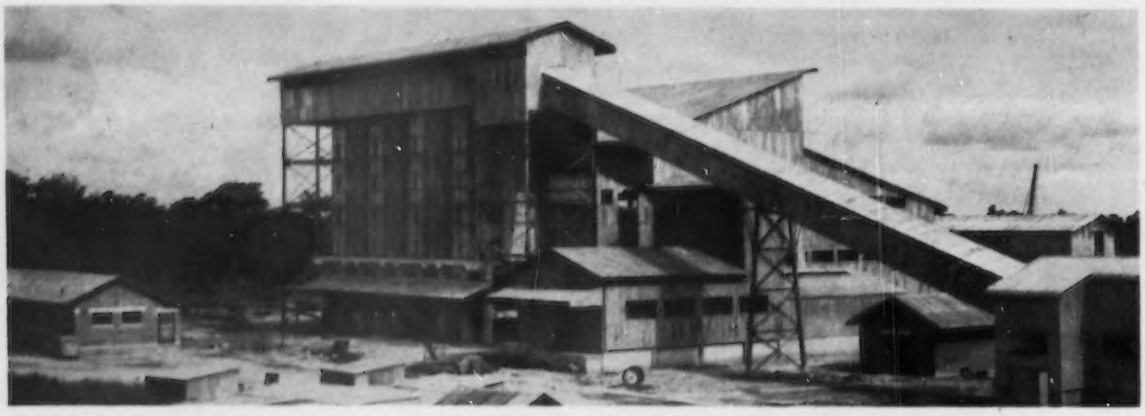
Present process, inaugurated last month, involves crushing, then grinding until 60% of the ore is less than 200 mesh, then separating the Cu and Co, the latter by flotation.

Concentrator, located at the mine site, is designed to handle some 40,000 tons ore per month. Building is divided into five sections: coarse crushing, fine crushing, grinding, flotation and filtering.

Ore from the underground mine



COPPER and cobalt are separated by flotation. Concentrates are shipped to two facilities: copper to Mufulira, cobalt to a brand new plant being built at Ndola.



FOUR fine ore bins flank main concentrator building. Each has 500-ton capacity. Concentrator office is at left.

TWO carriers, truck and rail, carry copper concentrates to the Mufulira smelter from the plant. Truck dumps at Nkana.

THREE bedrooms, garden, trees, characterize house in European township.

ONE of the more popular Copperbelt customs; recreation club and community hall.

arrives at the surface broken to minus 18-in. Jaw crusher takes it down to minus 5-in., product is then conveyed to two gyratory crushers, which reduce it to minus ⅜-in. A ball mill is next in circuit. Pulp is then pumped to the flotation cells for separation.

Copper concentrates from Chibuluma travel by road and rail to Mufulira, another RST property; cobalt concentrates are to be treated at Ndola Copper Refineries, Ltd., a plant now under construction by Chibuluma Mines Ltd. at Ndola, some 45 miles from the mine.

The mine currently employs some 200 Europeans and 1,250 Africans. Modern housing and other facilities have been provided.

Principal owners of RST are the American Metal Co. of New York (50.6%) and Selection Trust Ltd. of London. Officials at the mine site include Alec McNeil, manager; Dick Cornthwaite, underground manager; N. C. Sterley, resident engineer; and J. E. Harper, concentrator supt.

THE LOADER, an Eimco 630, loads one bucket while another is hoisted and dumped. Overshot unit handles boulders easily.

THE BUCKET is 3 ft high, 5 ft in diameter. Each is hoisted from its own headframe at the ends of the 37x14-ft shaft.

Crawler-Mounted Loader Speeds Shaft Mucking

FRED C. GRADDON

BY THE UNUSUAL APPLICATION of a new-type mechanical loader for shaft mucking, Vecellio and Grogan, Inc., a contracting company in Beckley, W. Va., is saving man-hours and promoting safer working conditions in sinking a shaft for the Pocahontas Fuel Co., Inc., in Virginia.

Original plans for sinking the large 37x14-ft shaft was to use airpowered clamshells on hoist cables, but so satisfactorily has the Eimco 630 crawler-mounted Rockershovel performed, that the clamshells were never installed.

Total depth on the completed shaft will be 520 ft which, at present, still leaves about 100 ft to be sunk. The shaft will connect with current mine workings and be used for service and ventilation.

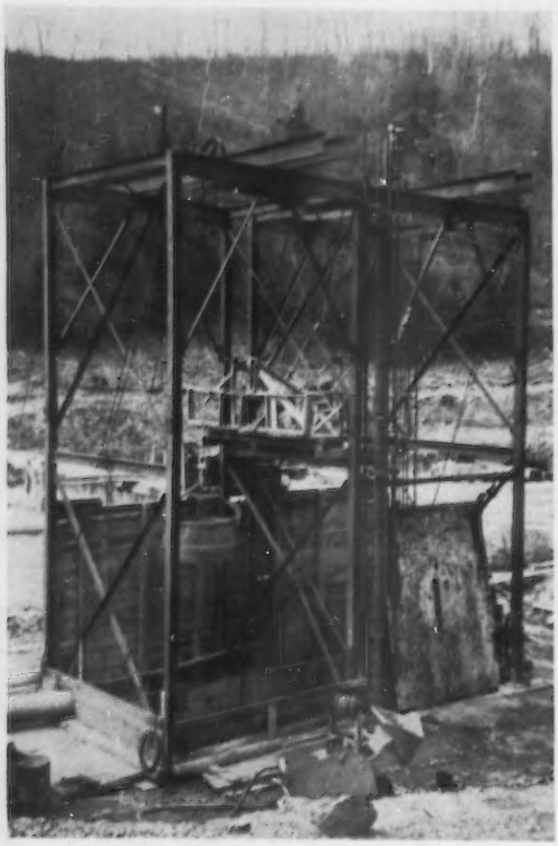
Rock penetrated is a series of flat-lying beds varying in hardness from a very hard sandstone to a very soft shale with occasional streaks of soft coal. Eight hours are required to drill and shoot the sandstone as compared to the 3 hr required to do the same work in the shale. A 6-ft round is drilled which usually breaks cleanly to the bottom. Frequently, in cleaning the bottom, enough rock is ripped loose to give another foot of advance for the round.

After shooting, the muck may be found piled in one end of the shaft or at both ends with a V-shaped low spot in the middle. Either way, it makes little difference to the Eimco 630. Early in the project, different methods of shooting were tried to obtain a flat muck pile, because it was easier to start the loader digging. While this is still the aim in blasting, it is not critical and affects operations little.

The loader fills buckets 3 ft high and 5 ft in diameter. With the large sized shaft, two standard headframes are used with two hoists, and it is easy to spot the buckets any place in the shaft. After one bucket is loaded, the Rockershovel simply spins around to load the second at the other end of the shaft. One bucket can be loaded in the time it takes to hoist the other to the surface and dump it.

There is an advantage, of course, to have the rock broken fine enough for easy handling, but so far the large rocks encountered have not seriously interfered with mucking speed. On the average it takes about 14 hr to muck out the shaft and prepare the bottom for drilling.

Mr. Graddon is a sales engineer with Eimco Corp. and works out of the New York office.



TWO HEADFRAMES have hinged floor on which bucket rests when loading men and supplies for drilling and concreting.

Credit for the equipment's fine performance is given to several design features. The ability to get a full bucket of muck at each pass in the muck pile is due, it is claimed, to the shape of the bucket, the angle of the bucket lip and the crowding action of the crawlers. Independently powered crawlers permit the operator to maneuver the loader in tight places for maximum effectiveness in digging and loading.

Sinking crews can actually advance the shaft 6 ft per day, but every 30 ft sinking is halted while the newest length of the shaft is concreted. Since concreting time is about equal to sinking time, the over-all advance of the shaft is 3 ft per day.

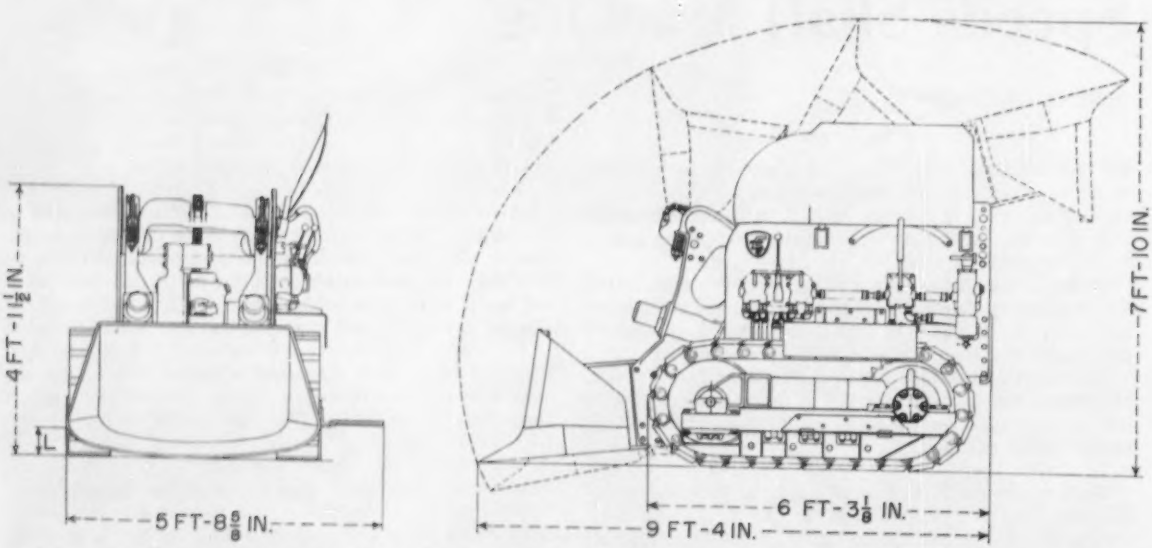
Drilling is handled by 7 Copco jackhammers using steel rods with tungsten-carbide inserts. A drill jumbo is not used, but a well designed drill carrier was made in the contractor's shops. Built of 3-in. heavy duty pipe, the frame serves as the valve manifold for the drill air lines. The water manifold is also built into the frame.

Operating procedure calls for all drills to be cleaned and checked and then placed in proper position on the carrier. After the loader has cleaned the bottom and has been brought to the surface, the drill carrier is lowered to the bottom and centered in the shaft. Air and water lines are connected between the pipe frame, and lines permanently placed in the concrete lining. Only one 50-ft length of 2-in. hose is used for both drills and loader. Air is supplied at 100 psi.

Basic crew on the project is headed by a shift boss with 7 drillers, a top man, mechanic and a hoist man. One of the drillers operates the mucking machine and the others assist in mucking and also service the drills. Each of the three shifts is supervised by a superintendent, with the entire operation in charge of George Swan, general superintendent. A carpenter and a timekeeper also work on the day shift.

More For Your Shaft Sinking File

Coming in your *E&MJ* Mid-June Mining Guidebook is a round-up of modern shaft sinking methods and equipment to round out your perspective in this important phase of mine development.



SNUG DESIGN of the loader makes it possible to load muck at either end of the shaft and spin around without trouble to load at the other end. After cleaning the bottom, loader is hoisted out of shaft and drill carriage lowered.

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Bulletin 25, Geology of British Guiana and the Development of its Mineral Resources, by G. M. Stockley for the British Guiana Geological Survey, Georgetown, Demerara, British Guiana. Photos, maps and 102 pp. Price $3.

Annual Report for the Year 1954, by the Chamber of Mines of Rhodesia. Printed by Rhodesian Printing & Publishing Co., Ltd., Salisbury, Rhodesia. 36 pp.

Paper 54-22, Notes on Columbian Mineralization, Oka District, Two Mountain County, Quebec, by Robert B. Rowe. Canada Department of Mines and Technical Surveys, Ottawa, Ontario, Canada. Report and map in 17 pp. Price 50c.

Handbook of Engineering Materials, by Douglas F. Miner and John B. Seastone. First edition of four sections covers all the materials of construction. Latest in the John Wiley & Sons, Inc. handbook series. 1363 pp. Price $17.50.

Problems and Control of Air Pollution, by Frederick S. Mallette. Proceedings of the 1st International Congress on Air-Pollution, 1955, ASME. Technical papers on control of sulphur gases, treatment and recovery of SO_2, new developments in air pollution control and dust collector design. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 272 pp. Price $7.50.

The Technology of Cement and Concrete. Volume I, Concrete Materials, by Robert F. Blanks and Henry L. Kennedy. Treats all the materials used in the making of concrete and examines their concrete-making qualifications. Part one of two. Main emphasis is on portland cement and aggregates. Chapters cover manufacturing of cement, aggregate preparation, aggregate prospecting, exploration, mining and analysis and testing methods. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 414 pp. Price $11.

Design of Prestressed Concrete Structures, by T. Y. Lin. Discusses loss of prestress, design for flexure, shear, bond, composite sections, continuous spans, columns and tanks. Additional chapters treat economics, fire and corrosion resistance, impact and fatigue strength. Sixty examples. Published by John Wiley & Sons, Inc. 451 pp. Price $11.50.

Barite-Fluorite Deposits in the Eastern Belt of the Sweetwater Barite District, Monroe County, Tennessee, by J. C. Dunlap. One map and 12 pp. On file at State Geologist, Division of Geology, Department of Conservation, G-5 State Office Bldg., Nashville 3, Tenn., and at the Geological Survey, 13 Post Office Bldg., Knoxville, Tenn.

Transactions of the Canadian Institute of Mining and Metallurgy and of the Mining Society of Nova Scotia, 1954. All the papers presented at the meeting. Volume LVII. Can be obtained from Society, in the Drummond Bldg., Montreal, Quebec, Canada. 523 pp.

Bulletin 170, Geology of Southern California, by the State of California Department of Natural Resources. Ten separate pamphlet-chapters, 34 mapsheets, 5 geological guides, all packed in one storage carton. Price $12.

Bulletin 46, Uranium-Vanadium Deposits of the Thompson Area, Grand County, Utah, by William L. Stokes. Can be obtained from Mines Bldg., University of Utah, Salt Lake City. 51 pp. Price $1.

Report of the Directors, 1954-55, by Ontario Mining Association. Can be obtained from Association at 320 Bay St., Toronto 1, Ontario. 40 pp.

Map, New Caldonia, L'Office de la Recherche Scientfique Outre-Mer 20, rue Monsieur, Paris (7°), annonce la parution d'une carte geologique de la Nouvelle-Caledonie a l'echelle du 100.000°. Prix 1.200 francs metro.

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Geology of the Brockton Quadrangle, Montana, by R. B. Colton. One map. On file at Geological Survey, 416 Electric Bldg., Great Falls, Montana; 315 Federal Bldg., Billings, Montana; 468 New Customhouse, Denver, Colo., and at the Office of the Director, State Bureau of Mines and Geology, Butte.

• Professional Papers and Bulletins from the Geological Survey may be obtained from Superintendent of Documents, Government Printing Office, Washington 25, D. C. Remittances should be sent by money order.

Professional Paper 262, Pleistocene Geology of Eastern South Dakota, by Richard F. Flint, as part of the program of the Department of Interior for the development of the Missouri River Basin. Maps and 168 pp. Price $3.

Professional Paper 268, The Central Kuskokwin Region, Alaska, by W. M. Cady, R. E. Wallace, J. M. Hoare and E. J. Webber. An account of the geography, geology, geomorphology and mineral resources including the occurrence and mining of quicksilver. Maps and 105 pp. Price $3.75.

Professional Paper 274-B, Dakota Group in Northern Front Range Foothills, Colorado, by Karl M. Waage. A revised subdivision and terminology for the Dakota group and local details of its stratigraphy. 49 pp. Price 45c.

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Bulletin 1024-B, Investigations for Radioactive Deposits in Southeastern Alaska, by Walter S West and Paul D. Benson. Map and 28 pp. Price 55c.

Bulletin 1036-B, Rapid Determination of Germanium in Coal, Soil and Rock, by Hy Almond, Harry E. Crowe and Charles E. Thompson. Modification of Cleeley's colorimetric determination of germanium in coal using modified phenylfluorone. Method can accommodate 50 samples a man day. 8 pp. Price 15c.

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Bulletin 1021-C, Geologic and Airborne Radioactivity Studies in the Rock Corral Area, San Bernardino County, California, by R. M. Moxham, G. W. Walker, and L. H. Baumgardner. Radioactivity in the area was attributed to thorium-bearing accessory minerals, chiefly allanite and zircon. Map and 16 pp. Price $1.

Bulletin 1027-G, Lithium Resources of North America, by James J. Norton and Dorothy McKenney Schlegel. A brief summary of the geology, distribution, production and resources. U. S. has more than adequate lithium reserves. Pegmatites contain 5-million short ton units of Li_2O. Searles Lake holds estimated 9-million stu. Production figures from 1889-1953. 25 pp. Price 15c. For full study of lithium industry see *E&MJ* Sept. 1955.

Bulletin 969-C, A Geological Reconnaissance of Parts of Beaverhead and Madison Counties, Montana, by M. R. Klepper. Map and 29 pp. Price 60c.

Bulletin 1009-E, Stratiography of the Morrison and Related Formations, Colorado Plateau Region, A Preliminary Report, by Lawrence C. Craig and associates. 41 pp. Price 20c.

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Fig. 2631-A Gate

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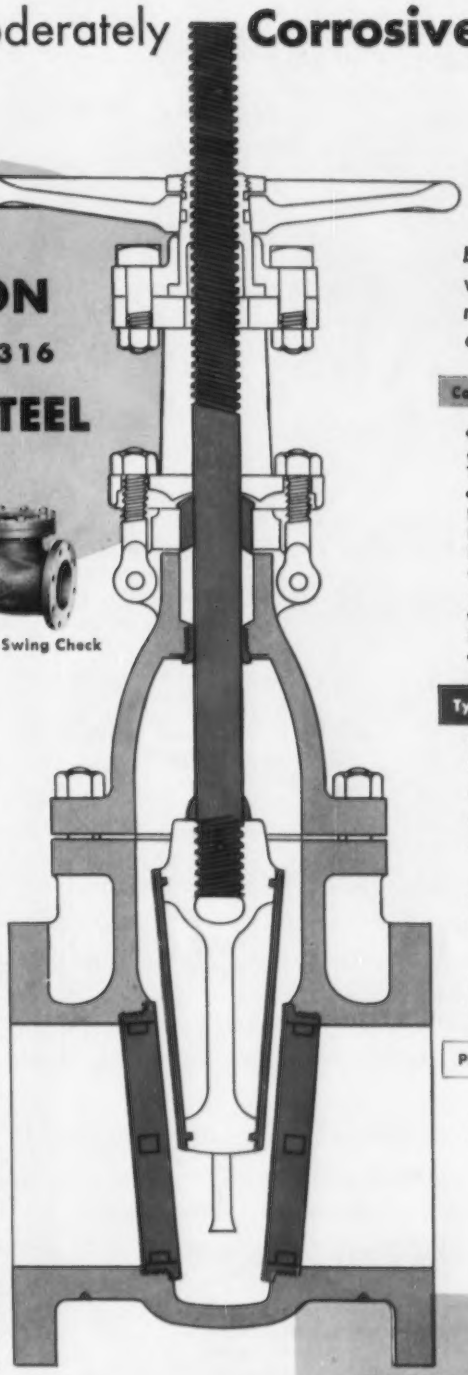
Fig. 2624 Swing Check



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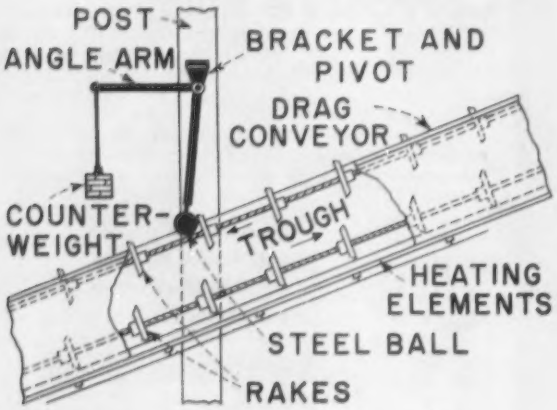
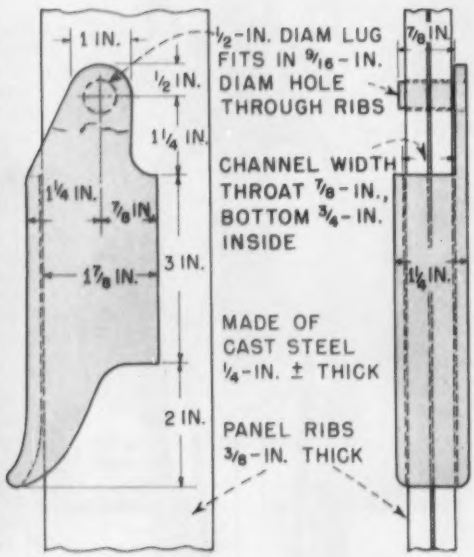


Swinging Ball Cleans Rakes

SIMPLE RAKE TAPPER is installed about midway between loading and discharge points of electrically heated drag conveyor handling finished tungsten concentrates. It keeps moving rakes free of concentrate particles, thereby assuring optimum carrying capacity. Devised by J. R. Caldwell, mill superintendent, Nevada-Massachusetts Co., Tungsten, Nev., it consists of a heavy steel ball, a steel angle arm and a counterweight. In operation, ball at lower end of vertical part of arm is raised by descending rake until it trips free and swings back to strike against next rake.

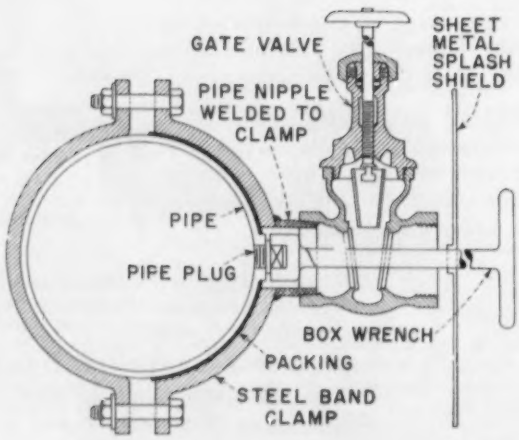


Simple Clamp Joins Form Panels

CONCRETE FORM PANELS are joined with simple, rugged and easy-to-use clamps at Bell Asbestos Mines Ltd., Thetford Mines, P.Q. Lug on clamp fits in holes, formerly used for bolts, in edge-rib of prefabricated aluminum sections. This lines up panels and lug serves as hinge so channel-like part of steel clamp can be swung over adjoining ribs to force them together. According to Henri Gagnon, mine superintendent, disadvantages of bolts—time consuming to place and remove, easily lost, troublesome when threads are dirty or stripped—are eliminated except in special situations. Clamp, cast of mild steel at local foundry, was adapted from one at Canadian Johns-Manville's Jeffrey Mine, Asbestos, P.Q.

Branch Is Put On Full Pipe

CLEVER METHOD was used recently to install branch pipeline without stopping main flow at lead-silver mine in central Spain. Fortunately, at intervals along main pipe, previously tapped holes were sealed with pipe plugs. First, pipe nipple was welded over hole cut in wide steel band clamp. Then after loosening pipe plug, packing and clamp was placed around pipe so plug was in center of nipple. A gate valve was attached to nipple and opened wide. A few turns on splash shielded box wrench, inserted through valve, removed plug and valve was quickly shut. Branch line was screwed into valve.



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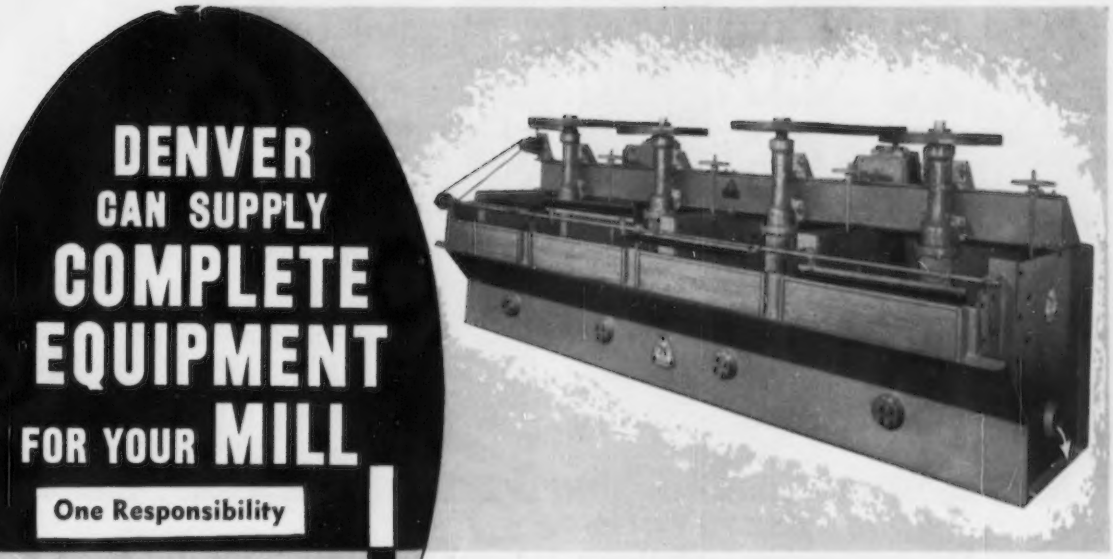

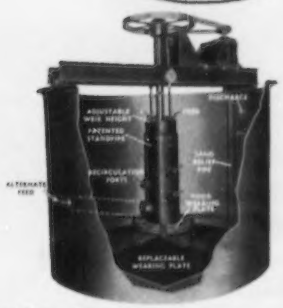

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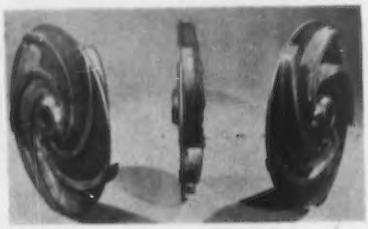
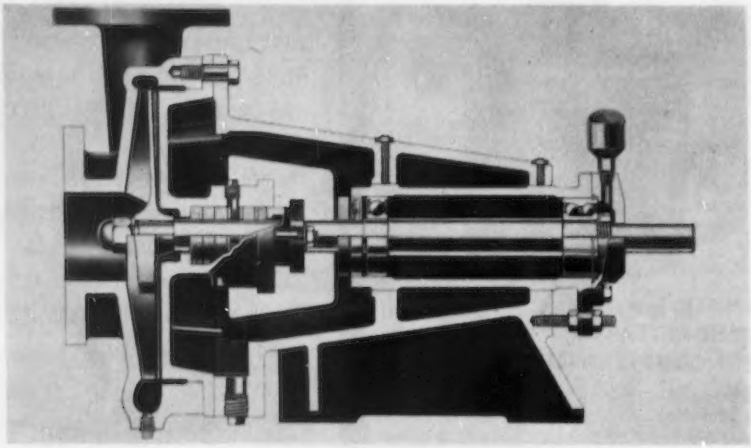
Dual Sampler and Power Scaler Simplify Two Jobs

MILL HEADS are sampled with a locally-made device that gives a duplicate sample at American Zinc Co., Mascot, Tenn. Incoming ore passes through primary crusher and portion of discharge is diverted to sample crusher. Flow from sample crusher is intermittently cut by sampler shown above. Two hollow sheet metal fans are rotated by electric motor so as to alternately pass through stream. Each fan empties into its own container in cabinet below. Uncaught portion drops through funnel and back to main stream.

Scaling in development drifts at Young Mine is done with lightweight air hammer and chisel bitted steel. Harry Miller, mine superintendent, says it makes a good clean job easier to do.





Eductor Vanes Cut Pump Maintenance

C. R. McFARLAND, De Laval Steam Turbine Co. Trenton, N. J.

STUFFING BOX MAINTENANCE, often regarded as unimportant because packing material is cheap, proves otherwise when costs of worn sleeve replacement, repacking time and "down-time" itself are considered. Use of mechanical seals is increasing but most services do not justify the higher costs.

Packing prevents pumped fluid from leaking out pump casing opening around impeller shaft. It is compressed around shaft by tightening stuffing box gland studs sufficiently to counter internal pressure yet permit enough leakage for cooling and lubricating to avoid short packing life and worn sleeves or shaft. The greater the pressure at internal end of box, the more compression and/or rings of packing required. This, in turn, results in an increased friction loss.

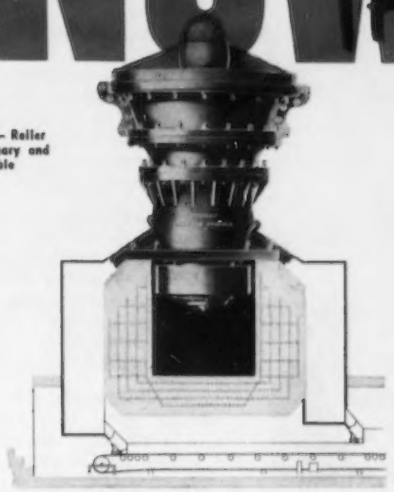
Stuffing boxes in single-stage double-suction pumps are subject to suction pressure which is usually less than pressure developed by pump, and sealing causes no great loss. However, end suction pumps for general chemical and small water applications usually have stuffing box on discharge side of impeller. This means stuffing box must withstand suction pressure plus pumping pressure with greater packing-pressure. Eductor vanes can solve this problem.

As photo shows, eductor vanes are on back of impeller and follow general contour of pumping vanes with eductor vane tips slightly ahead of pumping vane tips. Pumping action of eductor vanes creates low pressure at impeller hub and high pressure at periphery. Slight advance of eductor vanes develops pressure on back of impeller rim equal to or greater than pressure developed by pumping vanes, thus barring discharge pressure from stuffing box.

Shop tests show that at no flow, eductor vanes cut stuffing box pressure to 25% of discharge pressure; increasingly cut it to 8.3% at design capacity; and to zero at greater capacity. Even when impeller was worn (ground) to simulate replacement status, parallel results gave only 20% pressure at rated capacity. The effect also helps prevent suspended solids from entering hub area.

Though not new in principle, this eductor vane design has proven effective in reducing pump maintenance costs.

KNOWN THE WORLD OVER!



GYRATORY CRUSHERS – Roller Bearing, Gearless, Primary and secondary models. Double discharge outlets, synchronous motor built into pulley assembly or conventional V-belt drive. Power used only for crushing.

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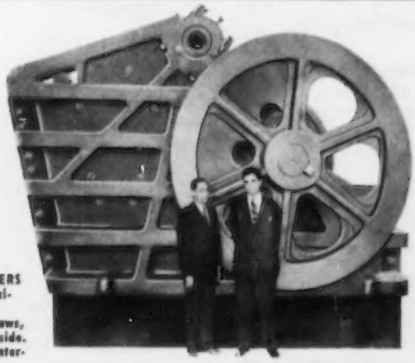
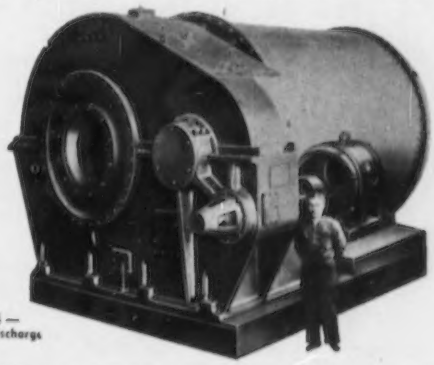
KVS sales-engineers are available for consultation anywhere, anytime.

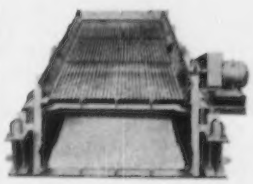


SWING JAW CRUSHERS – Heavy duty, maximum capacity and output. Reversible jaws, end-to-end, side-to-side. Kinetic power, counterbalanced fly wheel.

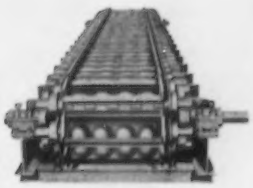


BALL & ROD MILLS — Center peripheral discharge

AIR SWEPT TUBE MILL – Integral drive, for fine grinding and pulverization



VIBRATING SCREEN – One, two or three decks. Interchangeable mesh, four-way motion. Portable or stationary models.



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PERSONALS

Asarco Executives Elected Vice Presidents

American Smelting & Refining Co., has announced the election of **Francis H. Eichler** as vice president in charge of the purchasing department, and **Frederick Walker** as vice president in charge of Federated Metals Division. Mr. Eichler joined the company 30 years ago as Pacific Coast credit manager and was named Los Angeles Plant manager in 1952. Mr. Walker, formerly assistant to the vice president in charge of the Federated Metals Division, joined Asarco in 1930.

Howard Evans, mineral processing engineer at the Oliver Iron Mining Division's research laboratory, has been named supervisor of the beneficiation laboratory at U. S. Steel's Columbia Iron Mining Co., Cedar City, Utah.

William C. Schmidt and **Neil A. O'Donnell** have opened an office as mining consultants, at 165 Broadway, New York 6, N. Y.

Joseph Rosenblatt, president of Eimco Corp., has been presented the Cross of the Legion of Honor by the French Government. The presentation was made by Robert Luc, consul general of France at San Francisco, during ceremonies at Salt Lake City.

John G. Pearcey has been transferred from American Smelting & Refining Co., and is now resident engineer for Southern Peru Copper Corp. in New York.

Robert H. Lyddan, regional engineer at the Atlantic regional office, USGS, has been appointed assistant director of the Geological Survey. Mr. Lyddan joined USGS in 1933.

Jack Barry has been named director of public information and reports by the General Services Administration. He came to GSA from the American Woolen Co., Inc., and was director of personnel and public relations from 1952 to 1955.

E. A. Lucas, executive vice president of Molybdenum Corp. of America, has received the honorary degree of Doctor of Science at Thiel College, Greenville, Pa.

Enders M. Voorhees, chairman of the finance committee, U. S. Steel Corp., has retired, but will continue as a director of the corporation, and member of the finance committee and consultant. **Robert C. Tyson** has been named to succeed Mr. Voorhees as chairman of the finance committee.

Owen Richards has been named manager of Metal & Thermit Corp.'s new mine and titanium ore dressing plant at Beaver Dam, Va.

Wilfred Sykes has been named honorary director of Inland Steel Co. upon his withdrawal from the board under a company policy of retirement. Mr. Sykes, a former president of Inland, retired from that post in 1949, and served subsequently as chairman of the finance committee and director. **John F. Smith, Jr.,** sales vice president, was named to fill the unexpired term.

Dr. Robert J. Anderson has resigned as head of the department of metallurgy, Southwest Research Institute, San Antonio, Tex., to join the Diamond Metal Co., Inc., as director of research and development. Before moving to Texas, he practiced as a consulting metallurgist for many years with headquarters in Cleveland, Ohio.

L. A. Woodward has been named administrative vice president of Kerr-McGee Oil Industries, Inc.

Dr. George A. Kiersch, former associate professor of the University of Arizona geology department, has spent the past year completing the mineral resources survey of the Navajo country in Arizona and Utah. He is director of the project which involves investigation of 11-million acres of Indian lands.

Harry J. Wolf, mining and consulting engineer of New York, has examined non-metallic mineral deposits in the Carolinas, and several uranium properties in Utah and adjacent states during the past few months; and has recently completed investigation of tungsten resources of Boulder County, Colo.

Jean Vuillequez, a vice president of American Metal Co., Ltd., has been named a director, succeeding **Bernard N. Zimmer,** who retired as a vice president in 1954, and served on the board since 1923. Mr. Zimmer had requested not to be nominated for re-election for a further term.

Marsh B. Tipton has been named general manager and vice president of Canadian Titanium Pigments, Ltd., a National Lead Co. subsidiary. **Harry Moon** will be plant manager of the titanium pigment manufacturing operation, now under construction. Mr. Tipton was assistant production manager of National Lead's titanium division from 1948.

H. S. Anderson, former manager of the Arizona Continental Uranium Co., Inc., has been named resident engineer of the New York & Honduras Rosario Mining Co. **Edward T. Knight,** exploration manager, has been named vice president of Rosario Exploration Co., a subsidiary. Mr. Anderson was also named a director of Rosario Exploration Co.

DR. JOHN F. WALKER, British Columbia's deputy Minister of Mines, was recently elected president of the Canadian Institute of Mining & Metallurgy at the Institute's annual meeting in Quebec.

You never run out of uses for a CAT* NO. 212

This Caterpillar No. 212 Motor Grader is equipped with a 40-foot crane which serves as a drill "jumbo." It is one of a number of Caterpillar machines in the underground mine of American Zinc-Lead & Smelting Co. at Picher, Okla. Four-cycle Caterpillar Diesels are ideal for this kind of work, giving efficient combustion and clean exhaust due to their trouble-free fuel injection systems. With properly designed exhaust scrubbers, Caterpillar Engines produce so little carbon monoxide, carbon dioxide and obnoxious gases that they are well within Bureau of Mines' limits.

The Caterpillar No. 212 has other features that are important in mining work, too. Like all other Caterpillar Motor Graders it is built—not merely assembled—by a single manufacturer. This means that engine, blade capacity and working speed are carefully matched for maximum efficiency and long work life. And it means a single, dependable source for parts and service: your Caterpillar Dealer.

Tubeless tires are now available on the No. 212 at no extra cost. They eliminate an estimated 80% of down time caused by tires, and last longer and are easier to service than ordinary tires.

Your Caterpillar Dealer has full information on the big No. 12, the No. 112, and the compact No. 212 Motor Graders. Ask him for a demonstration of the fast-acting controls, excellent operator visibility and other features that make Caterpillar Motor Graders the best in *any* mine.

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99% OF ALL CAT MOTOR GRADERS ARE STILL IN USE

Former E&MJ Editor Receives AICE Award

DR. HOWARD C. PARMELEE (left) was awarded a ruby-studded pin presented by **Prof. Walter G. Whitman,** (right) chairman, Dept. of Chemical Engineering, MIT, and president of the American Institute of Chemical Engineers. Dr. Parmelee, editor of *Engineering & Mining Journal* from 1933 to 1944, received the award for pioneering work in accrediting chemical engineering education, and his services as former secretary of the organization.

Charles C. Hilton, assistant industrial relations manager and personnel director, has been named industrial relations manager of Western operations, United States Smelting, Refining & Mining Co. Mr. Hilton joined the company in 1933.

Norman E. Ross, maintenance superintendent, Pacific Coast Borax Co.'s Boron, Calif., mine, has retired after nearly 40 years of service with the company.

B. C. Austin, mining engineer and consulting geologist, has been named president of Kalpure Oil Co., San Francisco, Calif.

Archie J. McDonell, former chief engineer and assistant plant manager, Tahawus plant of National Lead Co., has been named manager of the Sunbright plant of Foote Mineral Co. His earlier background includes 5 years with the Braborne Mines Ltd., in British Columbia, and 3 years with Cuyuni Goldfields Ltd., of British Guiana, where he served as general superintendent.

Dr. Irving Roberts, consulting engineer with Reynolds Metals Co. for the past 5 years, has been named director of planning with headquarters in Richmond, Va.

Francis H. Wemple, treasurer, Handy & Harman since 1954, has been elected a director of the company.

Lewis R. Sanderson, president of National Gypsum Co., has retired. **Fred A. Manske,** executive vice president, has been named to succeed Mr. Sanderson.

John E. Nyman has been named chemical laboratory supervisor of Oliver Iron Mining Division's Canisteo district. He has been with the company since 1945.

Frank L. Beggs, former mining and quarry superintendent, Coplay Cement Mfg. Co., Coplay, Pa., has been named production manager at Carbola Chemical Co., Inc., Natural Bridge, N. Y.

W. B. STEPHENSON has been elected president of Allen-Sherman-Hoff Pump Co., succeeding **Homer E. Allen,** named chairman of the board. Mr. Stephenson, former vice president, is succeeded by **Fred S. Stow.**

George T. Beardshear, mining engineer, has joined Pacific Isle Mining Co. as supervisor of mineral development. He formerly was with Oliver Iron Mining Division.

J. W. Koskinen, chief ore grader, M. A. Hanna Co., has retired. He joined the company in 1913, and will be retained to act as consulting chief ore grader. **Matt A. Bergan** will assume Mr. Koskinen's duties.

Kuno Doerr Jr., former manager of the East Helena plant of American Smelting & Refining Co., and now manager of the Garfield plant, has been named a director of Garfield Chemical & Mfg. Corp., and has been elected president.

Robert A. Whitman, connected with the inspection division of the General Services Administration in its minerals-buying program, has been transferred from Philipsburg to Butte, with headquarters in the offices of the Domestic Manganese and Development Co.

Dennis E. Leary has been named superintendent of the Washoe Sampler, Anaconda Co., succeeding the late **L. R. Margetts.**

OBITUARIES

Leslie B. Manning, 58, prominent Montana mining man and former president of the Mining Association of Montana, died December 25.

John T. Lewis Jr., 58, for 30 years employed by United States Smelting, Refining & Mining Co., and its former subsidiary Cia de Real del Monte y Pachuca, died May 2. He was manager of the Bayard department from 1951 to 1955 when he was transferred to Salt Lake City.

Warner Bushnell, 68, statistical engineer for Oliver Iron Mining division at Duluth, Minn., for 42 years, retiring in 1953, died April 9.

Alvin Adams Smith, 50, general superintendent of the Silver Bell Mines Co., Ophir, Colo., since 1946, died following a cerebral hemorrhage. He had been employed as a mining engineer and superintendent in Chicago, Detroit and Kansas City.

Marden W. Hayward, 73, mining geologist with the American Metal Co., Ltd., from 1915 to 1933, died February 4 at his home in El Paso, Tex. He was best known for the important part he played in the development of the Climax Molybdenum ore deposit and the copper deposits at Minas de Matahambre, Cuba.

Leslie I. Markel, 56, director of personnel for American Smelting & Refining Co. at Wallace, Idaho, for the past 20 years, died March 9. He first joined the Federal Mining & Smelting Co.

In Nevada...And the World Over

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IN open-pit mines everywhere, Bucyrus-Erie shovels like this 6-yd. 150-B are demonstrating their ability to strip overburden and load ore fast and economically.

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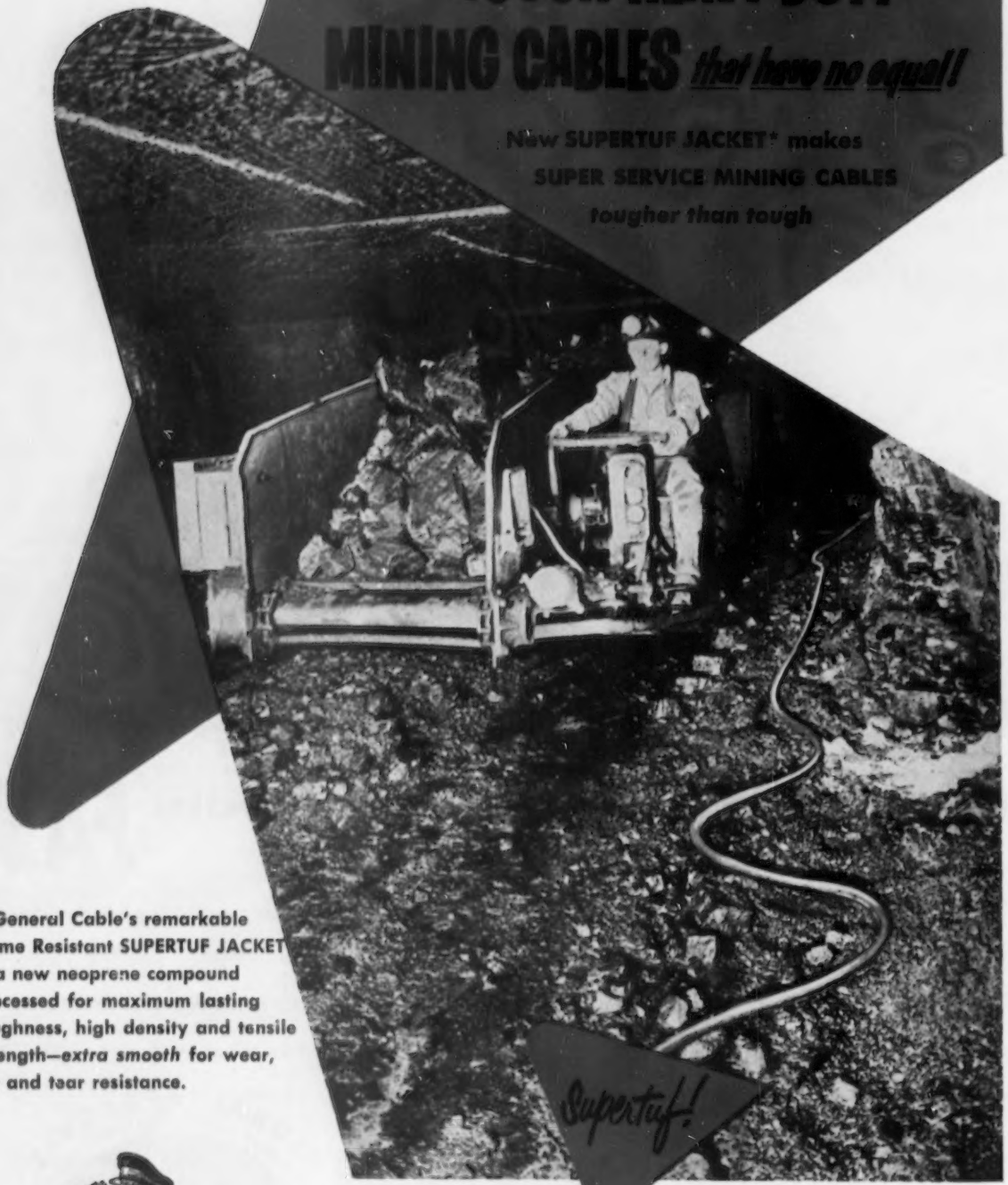

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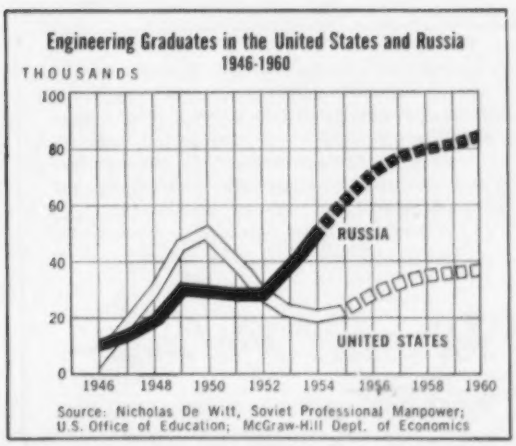
THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

Are We Losing the Race with Russia?

THERE is new confidence in the Kremlin. One key reason is expressed in a recent boast of Communist Party Secretary Khrushchev: **"The capitalists always regard our people as being backward, but today we have more engineers and more supporting engineering technical personnel than any capitalist country."** He promised that this lead would be widened and that communism would be victorious without war.

This boast cannot be dismissed as communist propaganda. Admiral Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, has warned: **"In five years our lead in the training of scientists and engineers may be wiped out, and in ten years we could be hopelessly outstripped. Unless immediate steps are taken to correct it, a situation, already dangerous, within less than a decade could become disastrous."**

This second editorial in a series on the shortage of scientists and engineers is designed to explore as carefully as possible the facts and the implications of the new emphasis on technical training in the Soviet Union. It draws heavily from the authoritative book *Soviet Professional Manpower*, prepared for the National Academy of Sciences and the National Research Council by Nicholas DeWitt of the Russian Research Center of Harvard and released recently by the National Science Foundation.



Trend Is Against Us

If the Soviet Union already has a lead in technical manpower, it is not very great. Both the United States and Russia now have around a million scientists and engineers. About a third of the Russian engineers were trained on inferior pre-1935 standards. **It's the trend — shown in the chart — that is alarming.**

Over the last five years we have turned out only 142,000 engineers, compared to an estimated 216,000 in Russia. In 1955 our output was around 23,000 compared to their 63,000. Over the next five years our projected output is 153,000, against at least 400,000 in Russia. There will be an additional 150,000 or more in the satellites and Red China.

In Russia, 30% of the college students are in engineering, compared to 8% here. Another 30% or more take degrees in natural sciences. Moreover, unlike ourselves, the Russians are

ploughing back a large proportion of their science graduates into teaching, which implies a rapid buildup in the future.

Quality As Well As Quantity

It would be foolhardy to assume that these new Russian graduates are inferior to ours in the quality of their technical training. They start out with much more intensive mathematical and scientific preparation at the high school level. They study harder and longer in college, with more laboratory work and more practical training. Their courses and textbooks seem to be as thorough as ours. Even though the Russian graduates may be overspecialized, they get results.

These results have been striking. The Russians developed both A-bombs and H-bombs faster than we expected, and it's not certain that they had to rely much on espionage. They pushed ahead of us for a while in jet fighter design, and they showed up with a fleet of long-range bombers well ahead of schedule. They are crowding us on nuclear power, electronics and automation. There are grave fears that they have established a lead in the vital field of military rockets.

The goal of Soviet scientific manpower policy includes not only weapon supremacy but also leadership of the neutral and uncommitted areas of Asia, Africa and the Middle East. The Soviet leaders may be bluffing in their offers to export capital, but they are preparing to export Russian scientific and technical know-how in a big way.

How They Do It

The Russians are determined to win the race for scientific supremacy, and they do not count the cost. **They pay their scientists and engineers salaries that seem fantastic when compared with other Soviet incomes.**

Senior professors, research scientists and top engineers are a major segment of the Russian elite. Their incomes are frequently six to ten times the average industrial wage. (In the U. S. six to ten times the average industrial wage would be $25,000 to $40,000 a year.) Housing and other privileges are correspondingly lavish. While preaching equality, the Soviets use capitalistic incentives far more boldly than we do. Indeed, practicing engineers and scientists have been complaining about the exalted status of professors and top research people, and salary scales are now being adjusted to give greater emphasis to practical results.

The Russians are also generous in their aids to education. Tuition has just been made free at all levels. Undergraduates receive 200 to 500 rubles a month and graduate students 800 rubles (about equal to an industrial wage) to cover living expenses. The biggest stipends go to science and engineering students. College students are deferred from military service, and engineers and scientists often enjoy continued deferment even after graduation.

Finally, the Soviet leaders can channel engineers and scientists — and all other human and material resources — into any area they choose. And the areas the Soviet leaders choose are predominantly those that contribute to military or political objectives, rather than to a better life for consumers.

What's Our Answer?

We are certainly not going to adopt Soviet methods. We do not want scientific robots, but free men, able to understand and add to our democratic heritage. At the same time, our world leadership in technology — and perhaps even our survival as a nation — will be threatened if we allow ourselves to lag far behind Russia in the training of scientists and engineers. Ways to keep the United States in the race will be discussed in a later editorial in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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IN SOUTH AFRICA

AROUND THE CLOCK

A TANK CAR AN HOUR OF H_2SO_4

This FluoSolids System at West Rand Consolidated Gold Mines, Ltd. on South Africa's fabulous Witwatersrand was started up early in 1952. The first of several to go into operation on the Rand, it was also the first in the world to combine FluoSolids roasting of pyrite with a contact acid plant.

Over 1650 tons of H_2SO_4 — enough to fill twenty-four tank cars — are being produced every day for uranium leaching at seven South African mills.

An important part of each of these installations is a Dorrco FluoSolids System. Cumulatively the Systems include nineteen Reactors, of which sixteen were on original order and three on repeat orders, plus additional Dorr-Oliver and auxiliary equipment to produce a high strength SO_2 gas for acid manufacture by conventional contact acid plants.

Total feed to the Systems is 1450 tons per day of pyritic gold mill tailings — averaging 35 to 45% total sulfur, gas production is 75,000 to 82,000 SCFM. Gas strength averages 12 to 13% SO_2 . . . sulfur recovery approximately 90%.

The efficiency and economics of the Dorrco FluoSolids System is in evidence in these facts. Additional representative proof that the FluoSolids process can produce an SO_2 gas at lower investment and operating costs than other roasters.

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WASHINGTON IMPACT

John C. L. Donaldson

Tungsten-Asbestos Extension Certain

DOMESTIC PRODUCERS of tungsten and asbestos got a new lease on life—if only a temporary one—last month, when Administration officials indicated a willingness to go along with one-year extensions of the ODM-GSA domestic purchase programs for these materials. These programs are scheduled to expire this month.

New hope also was injected in the Congressional drive to require Interior Department to come up with a long-range program of support for the mining industry at large.

Both developments came as the Senate Interior and Insular Affairs Mining Subcommittee headed by Sen. James Murray (D-Mont.) raced down the last lap of its broad "state-of-the-industry" investigations in an all-out effort to get under wire with some definite legislation before Congress adjourns next month.

The one-year extensions of GSA asbestos and tungsten purchase programs, and the authority for Interior to develop a continuing peacetime mining support plan were lumped into a compromise bill (S. 3764) introduced by Sen. W. Kerr Scott (D-N. C.). Previously, ODM director Arthur Flemming and Assistant Interior Secretary Felix Wormser had steadfastly opposed any new mining legislation —including (1) a resolution sponsored by Murray and bipartisan co-sponsors to require Interior to set up its long-range aid program, (2) a Murray bill to substitute Interior Department price supports for current ODM-GSA domestic purchase programs, and (3) a slather of bills to extend each of the purchase programs.

After a long and spirited push to "do something" for the industry, including White House conferences with President Eisenhower and his top adviser Sherman Adams, the Murray committee called Government witnesses to a penetrating and often bitter cross-examination on over-all Government minerals policy. It was a matter of days before Flemming and Wormser testified before this hearing that they each indicated willingness to go along with the Scott compromise bill.

What remained to be ironed out before any final measure is passed this Congressional session is how the compromise would be put into effect. Flemming—who maintains the position that ODM's responsibility lies in meeting emergency stockpile needs rather than supporting peacetime mining—views the asbestos and tungsten extensions "simply as a bridge, a stopgap, until Interior works out a long-range plan." Interior officials, on the other hand, think they have already offered a satisfactory plan in stepping up present Interior Department industry aids without any new legislation. They say they would increase funds used to encourage and develop new explorations, mining techniques, and so on—through already existing programs under DMEA, USBM, and other agencies.

Interior spokesmen say, however, they will continue to oppose any efforts to keep any mine in operation which "can't economically compete without artificial stimuli" unless that particular mine is essential to national security. Industry witnesses representing operators in each of the minerals now being bought by GSA for the ODM stockpile previously told the Murray committee that a steady domestic source of supply is essential in the event foreign sources—which supply the bulk of much mineral consumption in the U. S.—should be suddenly cut off.

Behind the two arguments lies a deep-seated U. S. foreign policy which militates against the Government giving the mining industry all it wants in the way of domestic help. First of all, industry requests for a protective tariff to balance off lower foreign cost factors run up against the Administration's announced trade policy. Second, the Government has for 10 years been committed to the view that we should help our underdeveloped allies economically.

State Department and ICA spokesmen witnesses told the Murray committee that the U. S. is no longer using Defense Production Act funds to finance natural resources development abroad. But long-range purchase contracts with foreign producers—signed not only to help them but to assure sources of needed strategic materials during the Korean conflict—are still in effect. And U. S. technological assistance is a basic plank in U. S. foreign policy toward underdeveloped nations. New economic emphasis on NATO, and an announced U. S. attitude of helping friendly countries without attached strings are recent indications.

In addition, there is some private investment of U. S. dollars abroad in the mining field. Some processors—refiners, smelters, fabricators—are not so disturbed as producers about foreign imports. In fact, a House Interior Subcommittee is looking into how much U. S. investment abroad is being used to develop foreign natural resources.

Producers, on the other hand, argue that without Government aid and protection against lower-cost imports, many domestic mines will have to close, with the result that the U. S. will be shut off from an important source in time of need. Many also testified before the Congressional probe that the nation could be made self-sufficient in a number of materials—tungsten and manganese in particular.

Government Clarifies Stockpile Policies

"BUY AMERICAN" wherever and whenever possible. That's the basic philosophy behind U. S. stockpiling policy, Office of Defense Mobilization assured industry late last month.

ODM released a previously classified directive outlining General Services Administration purchase programs, with this comment: "This directive emphasized that purchase should be made, wherever possible, from domestic sources in order to maintain the mobilization base of strategic materials in this country."

The reassurance came at a time when industry and Congressional criticism of the Government's attitude toward helping domestic producers in their competitive position with foreign producers hit a new peak (see previous story).

The ODM announcement also specifically declared a moratorium on all GSA buys of foreign-produced antimony and fluorspar "until the GSA has determined the possibility of acquiring additional quantities domestically."

ODM's statement also released for the first time a long list of materials, including lead and zinc, which GSA may acquire for its minimum, long-range, or so-called supplemental stockpiles (the latter above and beyond the long-range goals). This is the joint ODM-Agriculture Department barter program which has come in for sharp criticism in recent Congressional hearings.

However, ODM re-emphasized that the "Buy-American First" philosophy would be followed in this program, too. And it also assured industry that no acquisitions would be released on the open market. ODM spokesmen said the new directive merely restates policy in existence, does not and will not effect current or future Government buying and stockpiling programs, as far as foreign purchases are concerned.

Pentagon Describes U.S. Military Specifications

MILITARY CONTRACTS play an important part in creating markets for U. S. mine producers. This point was stressed at the Murray hearings last month on the state of the mining industry.

During the hearings, industry witnesses testified that the Defense Department has gone too far in conserving domestic minerals in its official specifications on such military items as jet engines, and other

Worried...

over production losses caused by excessive electrical maintenance?

Cheer Up!

JOY electrical connectors, portable lighting lines (String-a-lite) and cable vulcanizers will solve your problems quickly and economically. Specifically designed to provide years of dependable service under the most adverse operating conditions, they seldom need maintenance attention. Built to exceed the metal mining industry's highest performance standards, and backed by more than a quarter century of intimate experience with its needs, JOY products can be relied on to contribute a lot to increased production.

ELECTRICAL PLUGS AND RECEPTACLES . . . More JOY electrical connectors are used in mining operations than all other brands combined. Vulcanized to cord or cable as one-piece Neoprene jacketed units, they can't crack or lose shape when struck hard blows . . . are moisture and dust tight . . . and require no pampering to provide a long life of safe, efficient service. Hundreds of styles and sizes are available for mining needs. So for production's sake, remember JOY when you need electrical connectors . . . and in the meantime ask for your copy of Bulletin B56.

PORTABLE LIGHTING LINES (String-a-lite) . . . No special tools or talents are needed to hook it up or take it down. Can be quickly lengthened, shortened or moved to meet the exact needs of any working or passage area. Supplied in one-piece factory molded sections of 2 to 10 light outlets that inter-connect through JOY male and female "end-plugs" to make up the complete string. Choice of five socket and two end plug designs. Several styles of mating power receptacles also available. Bulletin B52 provides complete details.

CABLE VULCANIZERS . . . for rubber, Neoprene, Buna S and thermoplastic jacketed cables. Simple in operation, JOY vulcanizers quickly pay for themselves by making it possible to repair cuts and breaks in vital portable power lines immediately. Two types are available—"Steam" and "Direct Heat." Both are heated electrically with automatic temperature controls. Bulletin B48a describes these vulcanizers in detail and lists molds vs. cable sizes. Ask us for your free copy.

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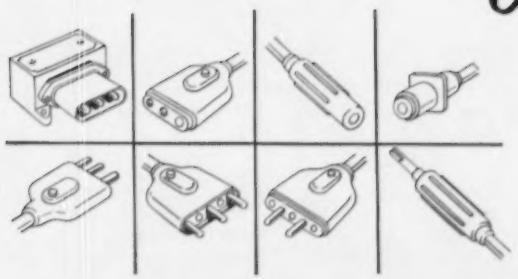

JOY

Specialists in Creating Electrical Connectors for Mining Applications, Since 1928

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Right down the steel production line . . .

Macks HANDLE THE IMPORTANT JOBS

Despite the punishing service, these husky, dependable Macks help keep steel production booming, right down the line. Like all Macks, they're engineered to the job, with extra stamina and staying power built in to meet the most extreme requirements.

If you haul important loads . . . Mack-sized loads . . . on fast long-distance highway runs, on start-and-stop delivery service through heavy city traffic, or operate over terrain where roads are unknown, it will pay you to standardize on Macks. Take advantage of Mack's unmatched experience, production skills and uncompromising standards of workmanship to get your cargoes moved on schedule, at the lowest cost per mile.

See your Mack factory branch or distributor.

FACTS ON MACKS

FIRST—FOR THE FIFTH YEAR! *Again in 1955, Mack was the unchallenged favorite among all diesel trucks—with 42.06% of total sales! The exceptional fuel economy of the Mack Thermodyne® Diesel engine, low maintenance costs, and amazing long life account for Mack's overwhelming preference among truck operators of every size in every field.*

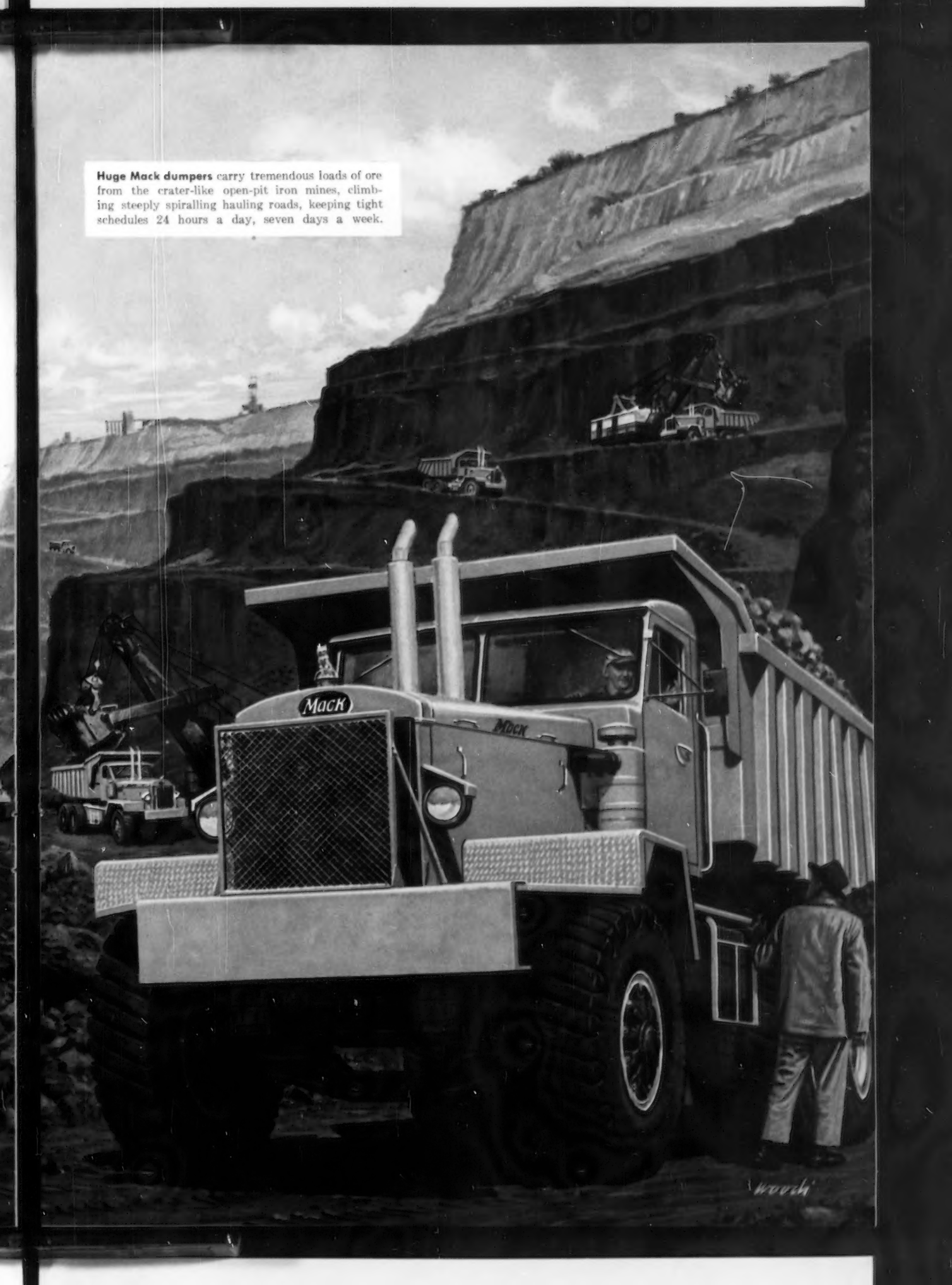
Mack

FIRST NAME FOR TRUCKS

Empire State Building, New York 1, N. Y.
In Canada: Mack Trucks of Canada, Ltd.

At iron and steel mills, Mack dump trucks haul slag from the enormous furnaces. Other Mack trucks shuttle semi-finished materials from one operation to the other on precisely-timed schedules, and deliver finished mill forms to warehouses.

Millions of pounds of steel—girders, window frames, beams, pipe and fastenings—for America's new schools, industrial plants and office buildings are delivered exactly when needed by Macks like the husky lightweight tractor shown on the job here.


Huge Mack dumpers carry tremendous loads of ore from the crater-like open-pit iron mines, climbing steeply spiralling hauling roads, keeping tight schedules 24 hours a day, seven days a week.
MACK
MACK

This 8-inch-diameter, 340-foot Armco Pipe line carries raw feed from a dredge to the processing plant.

Armco Pipe discharges the raw feed into this processing plant.

TO MOVE MATERIAL HYDRAULICALLY

Armco Special Analysis Steel Pipe
Gives you both abrasion resistance and structural strength

Whenever you move material hydraulically—whether in phosphate mining, dredging, slurry recovery or similar operations—you will find that Armco Special Analysis Steel Pipe gives you excellent abrasion resistance, plus high structural strength to withstand severe impacts.

Armco Special Analysis Pipe is supplied in a wide range of diameters (6 to 36 inches) and wall thicknesses (9/64- to ½-inch) to meet your size requirements. It is available in uniform lengths up to 50 feet. The long lengths mean fewer joints. Uniform lengths make replacement fast and easy.

Armco Pipe can be supplied with machine-reduced or expanded ends. Pipe ends can also be flanged or prepared for standard couplings or welding. Other special end finishes are available.

Write to us for information applied to your specific needs. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 5276 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Armco Special Analysis Steel Pipe

ARMCO®

new products of the nuclear age.

In answering these charges, the Pentagon came up with some interesting revelations.

1. Pentagon spokesman John Forry, Office of the Assistant Secretary of Defense for application engineering, categorically denied that military orders were holding down use of new materials and alloys, cited provisions in a Pentagon instruction booklet which states that no conservation is to be followed where efficiency is impaired.

2. New instruction guides are in the works at the Pentagon, and target goals in some cases may be raised.

3. Military equipment manufacturers and designers are not now using as much of the newer metals and alloys as they could under defense instruction guides. A case in point is tungsten. Tungsten witnesses at the hearings criticized military "orders" which held down the use of this metal in jet engines, despite the fact that its high heat resistance makes a better engine. Forry told the Committee that the target goal of 4.6-lb per thousand lb of thrust was raised late in April to 5.5-lb. Yet he said most jet engine designers are still using only "about half" of the 4.6-lb target.

ODM Assists Al, Ni

OFFICE OF DEFENSE MOBILIZATION has moved to alleviate two critical market shortages.

Aluminum—All stockpile calls for the remainder of 1956 have been diverted to private industry.

Nickel—New expansion goal of 440-million lb has been set; 140-million over current production and consumption rate. ODM director Flemming expects new bids from Bethlehem Steel, Freeport Sulphur, International Nickel and Farnsbridge Ltd.

The Capital—Coming Up

HEARINGS START this month on a bill by Rep. Saylor (R-Pa.) to authorize House Interior Committee to conduct a full-scale investigation of a possible coal research and development program similar to AEC's for atomic materials.

"Defense essentiality" is getting new emphasis. ODM hearings start soon on watches and fluorspar, to see whether these items need new tariff protection. The Joint Congressional Economic Committee this month will take a look at just how Government agencies such as ODM, Tariff Commission, and others determine "essentiality."

Defense Production Act is up this month for a two-year extension, expected to pass without significant amendment.

House Interior has started hearings on a bill to double the acreage of land leasable for phosphate mining in any one state to an individual or company—10,240 instead of 5,120. (10,240 acres the limit any one person or company may own throughout the U. S.)

Labor This Month

HIGH COURT DELAYS MINE-MILL TRAIL: The Government's case against the Mine-Mill and Smelter Workers union, already slow-moving, is almost at a halt. A Supreme Court decision, involving the Communist Party, has forced the Subversive Activities Control Board to hold up hearings on Mine-Mill. That decision ordered SACB to review the testimony of three suspect witnesses, including Harvey Matusow who has appeared in court against MMSW officials. The Subversive Board promptly called a halt to hearings on Justice Department charges that the non-ferrous mine union is Communist infiltrated. With further action put off, at least temporarily, it will be a long time before any results materialize from the Federal charges.

A similar Government case against the Independent United Electrical Workers Union, expelled along with Mine-Mill from the CIO six years ago on charges of Communist-domination, also is being postponed.

However, the electrical union case may be academic long before it runs the legal gamut. Defection by a series of IUE strongholds in the New York area to the rival AFL-CIO electrical union looks like the end of the road for the independent union.

For Mine-Mill, however, the delay in the Government's case supplies a welcome breather in the face of coming negotiations. MMSW is preparing for a big bargaining battle in two months with the non-ferrous industry, starting with demands for a 20c an hour pay raise plus a series of expensive fringes. With its troubles before the Subversive Board out of the way for the time being, Mine-Mill officials can concentrate on negotiations. Incidentally, the union intends to argue that no copper price hike is necessary to meet its demands for a new contract.

While the union, itself, temporarily avoids a defense against the Government's case, several officials are having their own troubles. Two officers, Graham (Cozy) Dolan and Bernard Stern, appeared before the House Un-American Activities Committee investigating Communism. But, there's little chance of any developments against the union from Congress. Any charges that are made to stick against Mine-Mill will probably be as a result of the Justice Department action—and that's a long way off.

MORE MERGER TALK—BUT NO ACTION: Mine-Mill is still seeking a home in the new AFL-CIO. Its officers have been meeting with the big Steelworkers Union about teaming up, but with no results.

This has a double-barrelled purpose: to get under the protective wing of the merged labor federation, and to avoid a continuing membership war with the steel union. While MMSW leaders continue to hope for results, there's almost no chance they can work out a deal.

NEW LABOR LEGISLATION IS OUT OF THE WINDOW: Any lingering hopes by union leaders for action on labor measures at this session of Congress were killed with a change of committee assignments on Capitol Hill. Illinois Senator Paul H. Douglas, who has carried the ball for the unions in the Senate Labor Committee, left that job for a post on another committee. This immediately stalled hearings on extension of the minimum wage law and almost assured no action at this session on other measures. It means that current bills on Federal aid to depressed areas and Federal check-reins on union welfare funds will be put over until next year. With Douglas' departure, the unions are left without a champion in the Senate, at least from the vantage point of the strategic Senate Labor Committee.

However, the blow isn't as severe as it might have been. Congress has been marking time on labor issues, and there was little hope, even with Douglas at the helm, for any major labor provisions passing this session. Taft-Hartley is a dead issue; extending coverage of the minimum wage law to retail and service workers faces too much opposition for approval this year. The depressed area and welfare fund bills seemed to have a chance earlier in the year but both bills bogged down.

Union strategy, in pushing its programs, has been to make a political case for the coming campaign and to set up the record for the new Congress.

Alan E. Adams

NEW PRESIDENT Norman E. Ebbley (right) is congratulated by other principal figures attending 1956 annual meeting. Left to right are: Adm. R. W. D. Woods, president of Minerals Corp. of America; Tom Skidmore, retiring president; Stephen L. R. McNichols, Lieutenant-Governor of Colorado and UOPA counsel; Ebbley, vice-president, Mid-Continent.

Ore Producers Discuss Output

URANIUM PRODUCTION was the dominant theme of this year's meeting of the Uranium Ore Producers Association, held May 10 to 12 at Grand Junction, Colo. Members noted a trend in both technical sessions and equipment displays away from the prospecting emphasis toward output, its ways and means.

Norman E. Ebbley, former first vice president of the organization, was named president, succeeding Tom Skidmore, Delores, Colo. Ebbley, a resident of Grand Junction, is vice president and general manager of Mid-Continent Uranium Corp.

Uranium Institute of America, formed last winter as a public relations and research arm for the industry, met as the convention opened. Adm. R. W. Woods (USN-Ret.) president of Minerals Corp. of America, was named chairman of an executive committee which will direct institute action until a permanent 25-man advisory board is chosen

Allen E. Jones, manager of the AEC's Grand Junction operations office, was principal speaker at the banquet.

The Atomic Energy Commission plans no more withdrawals of public lands for Government exploration, he said.

Lands presently withdrawn on which no definite ore reserves have been established will be quickly restored to private prospecting.

"Now that private industry has taken over much of the direct exploration work formerly done by the Commission," Jones said, "the Commission is placing the emphasis on the study of geologic features associated with uranium ores and the development of geologic information to assist private prospecting. Another major job is to follow the widely scattered private prospecting activity to appraise the need for milling facilities, and evaluate the nation's actual and potential uranium resources."

Jones revealed that AEC shortly will have its procedures in hand for the commencement of operations under its new leasing policy. (For AEC's new plan for U_3O_8 purchases, see page 72.)

"Commission-controlled ores will be leased as needed to meet the commitments for ore in present milling contracts. As no new commitments are being made in the current contracts, ores not needed will be held as a reserve for future uses as may be required.

"Although 1955 was a banner year for processing capacity expansion, it will not compare with 1956 in the great upsurge of interest in building mills on the part of private industry.

"The first four months of this year have brought the greatest profession of interest in uranium mill building ever experienced in the Grand Junction office. As pointed out earlier, this reflects the rapid rate of discovery and climbing ore reserves of the past year. As of this date, ten formal mill proposals are before us. Eight of these are for new mills and two are for expansions of existing mills. Several are in final stages of negotiation. There are a dozen or more firms who have indicated interest in building a mill and have had preliminary discussions with us."

Mr. Jones reviewed the nature of milling contracts and stated: "The primary objective of the Commission is to obtain uranium concentrate at a reasonable cost. At the same time, the Commission wants to give the mining and milling people the chance to operate on a private industry basis, with as few AEC controls as possible.

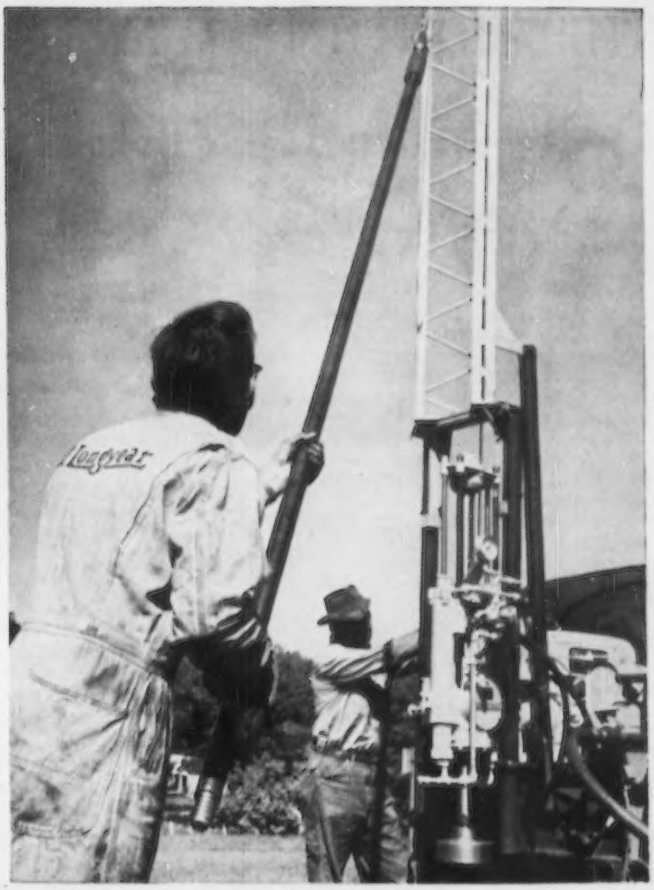
Australian News and Information Bureau photo

Australia Mines, Separates, Ships Rutile

WITH PROMISE of expanded production in 1956, Australia is mining rutile from its beach sands on the Queensland-New South Wales border, separating the minerals, and shipping some 50,000 tons per year. Simplicity of recovery is shown above, with tractor piling the black sand; shovel loading into ore cars. Along with the operations on the Pacific Coast, Australian authorities have also announced plans of "a British group" to begin work within a few months on development of a rutile deposit on Bathurst Island, 40 miles north of Darwin. "A special dredge is being built in Britain," the report says, "for developing the leases, which cover an area of 1,400 acres."

Longyear

Longyear mobile drills tame the Colorado Plateau!



Jeep-mounted "24"
Capacity-750 feet of EW rod

Trailer-mounted Junior Straitline
Capacity-1350 feet of EW rod

Truck-mounted "44" (heavy duty)
Capacity-4000 feet of AW rod

FAST MOVING, VERSATILE LONGYEAR RIGS CUT TIME AND DISTANCE BETWEEN JOBS

PROVED . . . *rapid movement from one drilling operation to another . . . speedy transport of men and equipment.* Longyear mobile drills cancel many problems of distance and rough terrain. Rugged, realistic design assures maximum efficiency in remote areas.

PROVED . . . *time saved in setting up at drill site.* Longyear mobile drills hold setting up time to an absolute minimum. Drill teams arriving at site are ready to start drilling almost immediately.

PROVED . . . *better drilling results at less cost.* Longyear mobile drills are engineered with "built-in" versatility to help you solve a variety of problems, such as:

- proving up metallic and non-metallic mineral values
- foundation testing
- strip mining
- testing quality and depth of coal measures
- revealing the depth and nature of overburden
- soil sampling

Longyear welcomes the opportunity of explaining the advantages of mobile drills in detail. Our recommendations are supported by more than 65 years of experience in solving actual field problems.

Write for General Bulletin #96

E. J. Longyear Co. MINNEAPOLIS, MINN. · CABLE LONGCO

CANADIAN LONGYEAR LTD., NORTH BAY, ONTARIO · LONGYEAR ET CIE., PARIS, FRANCE

Delta Mine Reserves Set at 135,000

DELTA MINE which prospector Vernon J. Pick sold to financier Floyd B. Odlum, president of Atlas Corp in a $9-million deal Aug. 31, 1954 only has 135,000 tons of proved ore reserves.

This startling, and long-rumored fact along the Colorado Plateau, is disclosed on page 11 of an 85-page prospectus which Atlas Corp. recently filed in Washington, D. C. with the Securities and Exchange Commission.

At time of the sale, it was announced that the Delta mine along the Muddy River in southern Emery County, Utah, had ore reserves of 300,000 tons.

Subsequently, this proved ore reserve figure was hiked by Atlas to 600,000 tons. Later the mine was put into the Hidden Splendor Mining Co., Atlas' wholly-owned subsidiary.

The 135,000 tons of ore averages 0.35% uranium oxide in grade and is worth $4,083,750 in place. (Price including premium and developmental allowances but before production bonus [$35,000] and haulage allowances.)

At 300,000 tons of 0.35% grade ore, the reserve in place would be worth $9,075,000 at $30.25 a ton.

These figures don't take in mining costs, placed at $5 a ton or actual developmental and exploration costs. The prospectus states that during ownership by Hidden Splendor, some 60,000 ft of inside drilling and 12,000 ft of drifts, tunnels, et al, were completed, cost of which is not revealed in the document.

Five-dollar-a-ton mining costs are among the lowest on the Colorado Plateau.

The decline in reserves cannot be attributed to production.

Prospectus states: "Commercial operation of the mine commenced on July 1, 1955. During the period July 1955 through January 1956, Hidden Splendor mined, shipped and sold approximately 5,000 tons of ore per month (or total of 25,000 tons). Production was increased to approximately 6,000 tons per month during February and March 1956. Direct mining costs, including administrative expenses, during such period averaged approximately $5 per ton."

The prospectus continues: "Based on exploration and development work to Nov. 30, 1955, Mr. Walter Verner, independent consulting geologist of Grand Junction, Colo., has reported to Hidden Splendor that, in his opinion, ore reserves of Jan. 1, 1956, amounted to approximately 135,000 tons of proved ore, having an average uranium oxide (U_3O_8) content of 0.35%. Mr. Verner has also reported that radiometric probing of inside drill holes and the projection of the Delta sand beyond the limits of the proven orebody within perimeters established on the basis of the geological structure of the area, indicate the existence of a substantial additional quantity of mineralized material amounting in the aggregate to approximately 360,000 tons. However, with respect to that portion of the area explored by radiometric probing, such probing may not accurately establish the uranium content of the mineralized material encountered, and further work will be required before a final determination as to whether or not such material consists in whole or in part of commercially mineable ore. It is estimated that such further work will commence during the late spring of 1956 and that, in connection therewith, production at the mine may be cut back to approximately 2,500 tons per month. During such period, certain of the personnel and equipment of Hidden Splendor will also be employed to expedite exploration and development work on the Daniel Ruddock claims in Big Indian district, San Juan County, Utah."

At the Atlas meeting, stockholders were told . .

Recent "confusion over proven reserves in the Delta" arose from a difference in interpretation of terms used by SEC and private geologists. SEC specifications, according to Floyd Odlum, involve blocking out the ore on three sides; impractical in view of the terrain around the Delta.

Odlum said, "It is necessary to consider the operations of the Delta mine as a part of the whole Hidden Splendor operation", and said the investment on the properties should pay out early in 1960, with a yield of 10% after taxes. At that time, he said, the mines should still have 350,000 tons reserves.

The prospectus relates how, in effect, the explorers "ran out of ore," stating: "The orebody at the Delta mine of Hidden Splendor is located in a sandstone channel, termed the Delta sand, which lies at the base of the Chinle formation and trends in a northeasterly direction from the mine mouth.

"Since the acquisition of the Delta mine, Hidden Splendor has been continuously engaged in exploratory work in the channel for the purpose of determining ore reserves and in development work preparatory to commercial mining. At November 1955, tunnels and drifts aggregated approximately 12,000 ft and inside drill holes aggregated approximately 60,000 ft. Part of such underground exploration work was conducted to a distance of approximately 600 ft northeast of the present boundary of the proven orebody in search of an extension of the known channel. However, the work showed a sharp decline in width and thickness of the channel, and no commercial orebodies were encountered. In addition, Hidden Splendor has conducted a drilling program to the north of the mine workings exploring for a parallel channel and has also drilled two holes to the northeast of the mine workings exploring for an extension of the presently known channel. None of such surface drilling has disclosed ore of commercial grade and thickness but one of the holes to the northeast encountered a mineralized zone which appears to be an extension of the Delta sand."

There is no direct statement in the prospectus regarding this change in ore reserves. However, the prospectus does contain a statement which may be a reference to the reserve problem:

"In a new and rapidly developing mining area such as the Colorado Plateau, where uranium orebodies usually are not represented by outcrops or vertical veins that reach the surface, but are in the form of layers, channels or lenses generally horizontal in direction and substantially below the surface, opportunities for establishing the existence of commercial grade ore by tunnels and drifts and by sampling exposed ore faces are relatively few."

Major Companies Increase Reserves

WITH THIS ISSUE, *E&MJ* concludes its survey and digest of the annual reports of the major companies in the mining industry. Previous sections appeared on page 72 of the April 1956 issue and on page 126 of the May issue.

Consolidated Discovery Yellowknife Mines, Ltd. which started production in January, 1950, each year has shown an increase in bullion production, earnings and working capital. A 50% expansion of mill capacity will be completed this July. Capacity then will be 125 tpd. Company milled 38,693 tons, recovered 66,742 oz gold and had 163,635 tons, 1.6 oz gold reserves. Net profit for 1955 was set at $679,842.

Radiore Uranium Mines, Ltd. reported that Eldorado Mining & Refining, Ltd., operators of Radiore's Ace Mine, will expand Eldorado milling capacity from present 700 tpd to 2,000 tpd. (This presumably is to take care of ore from Ace, Verna and Radiore and other new mines.) Company is exploring and drilling near

(*Annual Reports Continued on p 200*)

What are Your Fertilizer Plant Design Requirements?

PHOSPHORIC ACID

Dorr-Oliver designs plants for producing strong acid (32 to 33% P_2O_5) directly by its well-known process using the revolutionary new Dorr-Oliver Traveling Pan Filter.

DIAMMONIUM PHOSPHATE BASED COMPOUNDS

Dorr-Oliver designs plants producing directly from 32% P_2O_5 phosphoric acid a wide variety of compounds such as 14-14-14, 14-28-14, 12-36-12, 11-48-0, 16-20-0 and 18-48-0 as hard, uniform, free-flowing granules based on mono or diammonium phosphates.

PHOSPHORIC ACID EVAPORATION

Dorr-Oliver designed vacuum evaporator stations eliminate serious scaling, reduce P_2O_5 losses to a negligible point and involve no fume problem.

TRIPLE SUPERPHOSPHATE FOR DIRECT APPLICATION

Dorr-Oliver designs plants to produce hard, uniform, free-flowing granules by its own process requiring evaporation to only 38% P_2O_5 with no need for subsequent curing.

NON-GRANULAR TRIPLE SUPERPHOSPHATE

Dorr-Oliver designs plants for producing a soft triple superphosphate with optimum characteristics for mixing and ammoniation.

Dorr-Oliver has had 40 years' experience in the field of concentrated fertilizer production via the wet process of manufacturing phosphoric acid. Dorr-Oliver designs and builds complete plants.

Let us send an engineer to discuss your requirements.

MIXING AND GRANULATION

Dorr-Oliver designs plants for producing compounds in the form of hard, uniform, free-flowing granules from a variety of raw materials in solid or liquid form.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
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McLanahan Welded Steel Log Washers are smooth running, highly efficient machines for removing tough clays, soft rock and other materials from iron and manganese ores, barytes, zinc, ochre, peat, limestone, trap rock, sand and gravel, phosphate, gold and other ores. These machines remove high percentages of undesirable refuse—providing savings that more than pay for the installation in a very short time. A few of hundreds of applications are illustrated below.

TYPICAL INSTALLATIONS OF McLANAHAN LOG WASHERS

Two pairs of 30' McLanahan Logs, used for cleaning sand and gravel in Virginia.

McLanahan Paddle Mill and Log Washer cleaning Texas limestone.

Write Today for Bulletin WLO-1253

New and old type McLanahan Log Washers used here remove clay from cement rock in Pennsylvania.

McLANAHAN & STONE CORPORATION

PIT, MINE AND QUARRY EQUIPMENT HEADQUARTERS SINCE 1835

255 Wall Street, Hollidaysburg, Pennsylvania

THIS MONTH *(Continued)*

New Mill Construction Creates AEC Shortage

SURGING CONSTRUCTION of new uranium mills and increasing number of applications for mill permits to the Atomic Energy Commission has created a need for additional personnel in the Processing Division of the agency.

Qualification standards for such positions are as follows:

"Graduate engineers with a minimum of 5 years experience in the design, construction or operation of ore beneficiation plants. Annual salary range $6,390 to $7,570 dependent upon qualifications and experience."

It is requested that applicants submit a resume of education, experience, and personal history to the Personnel Office, U. S. Atomic Energy Commission, Grand Junction Operations Office, Grand Junction, Colo.

Mining Calendar

Fourth annual Human Engineering Institute. Stamford, Conn., June 18-22.

Annual meeting, American Society for Engineering Education. Iowa State College, Ames, Iowa, June 25-29.

Uranium & Atomic Industry meeting. Denver, Colo. June 25-26.

10th meeting, European Assn. of Exploration Geophysicists. Hanover, Germany, June 25-29.

American Society of Training Directors, Michigan State University, East Lansing, Mich., July 9-20.

Rocky Mountain Mineral Law Foundation, second annual meeting, Boulder, Colo., Aug. 2-4.

International Geological Congress, 20th Session. Mexico, D. F. , Sept. 4-11.

Rocky Mountain Minerals Conference, third annual session, AIME, Salt Lake City, Utah., Sept. 26-28.

German Society of Metallurgy and Mining, general assembly. Klagenfurt, Austria, Sept. 26-29.

American Congress on Surveying and Mapping and American Society of Photogrammetry. Denver, Colo., Sept. 30-Oct. 2.

American Mining Congress Mining Show, Shrine Exposition Hall, Los Angeles, Calif., Oct. 1-5.

Society of Exploration Geophysicists, 26th annual meeting. New Orleans, La., Oct. 25-Nov. 1.

Berkely Aims at 17,500 Tpd

PRODUCTION of copper ore from Anaconda Co.'s Berkely Pit "will have reached 17,500 tpd by mid 1957," according to Roy H. Glover, chairman of the board. Discussing company opera-

WE WANT YOUR TOUGH JOBS!

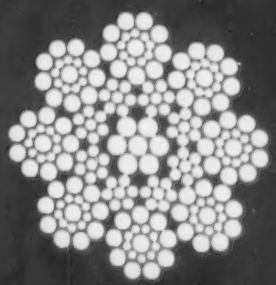
for J&L CenterFit Wire Rope

Three characteristics give J&L CenterFit Wire Rope the staying power to develop outstanding service in applications where shock, fatigue, and heavy loading limit the service life of standard wire rope.

1. CENTERFIT is the strongest standard rope produced.
2. CENTERFIT is more flexible in operation than any standard IWRC rope.
3. CENTERFIT has unsurpassed resistance to shock loading.

Over the years CenterFit has built a record for outstanding service life on the toughest applications such as shovel hoist ropes, back hoe pull ropes, and clamshell holding and closing lines where overloading is a factor.

If you're operating where loading, shock and fatigue are severe, chances are J&L CenterFit can help you cut your wire rope costs. Contact your nearest J&L Office or representative.



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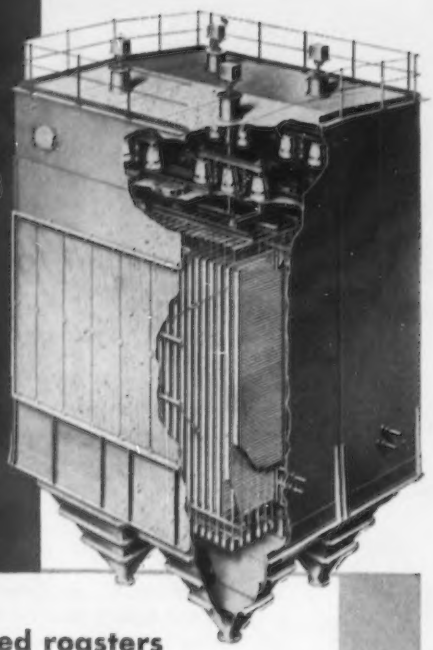

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Bulletin GB describes in detail the construction and operation of Research-Cottrell precipitators. Write for your copy today.

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Berkely Pit *(Continued)*

tions at the annual stockholders meeting. Glover noted that Anaconda is inaugurating the "northwest project" for revitalization of the Butte District underground operations. "We can confidently look forward to a longer and greater future even than the period of Butte's glorious history as a mineral producing area," he said. Berkely output by year-end is expected to be 10,000 tpd.

Mining Expenditures To Rise 34% For This Year

THE MINING INDUSTRY will spend 34% more in capital expansion in 1956 than it did in 1955, according to the annual survey of business plans by the Economics Department of McGraw-Hill. Actual spending in 1955 was set at $318-million, compared with planned spending of $427-million this year. Preliminary plans for 1957, 1958 and 1959, as reported to the department show $325-, $331- and $302-million respectively.

The following table shows how mining and steel companies will expand capacity through 1959 and the percent of increase. Index for industrial capacity is 100% for 1950.

	1956	1959	%
Iron and steel	127	149	17
Non-ferrous metals	166	212	28

For the first time in the history of the McGraw-Hill survey, business plans for two years in advance were equal to the current year. Over-all business plans show expenditure of $39-billion this year; expansion of capacity in major areas; introduction of new products and increased funds devoted to research and development.

Atomic Industry Meeting Set for Denver, June 25

MORE THAN 400 leaders of the atomic energy and mining industries are expected to attend the "Uranium and Atomic Industry" meeting to be held in Denver, Colo., June 25-26, co-sponsored by the Atomic Industrial Forum and the University of Denver's Research Institute.

Jesse C. Johnson, director of AEC's raw materials division, will be the featured speaker. Others include Dr. Amasa Bishop, chief of the AEC controlled thermonuclear branch, who will discuss the fusion reaction and the impact of controlled thermonuclear program on the uranium industry; R. E. Barrett, manager of uranium procurement, Atomic Energy of Canada, Ltd.; C. D. W. Thornton, assistant to the president, Farnsworth Electronics Co.; and Howard E. Kremers, technical assistant to the president of Lindsay Chemical Co.

Dr. Alex Stewart, vice president and director of research, National Lead Co., will discuss processing, Ewell E. Mason, of Internuclear Corp. will talk on radiation applications of atomic energy. Donald L. Everhart, geologic advisor to AEC at Denver, will discuss uranium geology.

NEW D9 TRACTOR

Moves more than 600 cubic yards of shale per hour!

This big new CAT* D9 Tractor 'dozes over 600 yds. per hour over a 100-ft. push. Its No. 9A blade handles 12 to 15 yds., trench-dozing on a 30% favorable grade. Material is shale base course for a haul road at Monsanto Chemical Co.'s Soda Springs, Idaho, phosphate mine.

Like all Cat-built equipment, the new D9s are engineered to do more work with less down time at low cost. Morrison-Knudsen Company, Inc., owns this and other giant Turbocharged 286 HP D9s here, purchased because of previous experience with Caterpillar equipment. The company also has Caterpillar D8 Tractors on this job.

The D9s are working in the phosphate beds of southern Idaho, largest known deposit in the world. The giant yellow "Kings of the Crawlers" strip overburden, which varies from 6 ft. to 10 ft. in depth, and feed ore to the shovel. These great new yellow machines are the product of many thousands of hours' testing on proving grounds and actual construction and mining jobs.

The D9 is tough and traditionally Caterpillar from its completely new, 4-cycle engine with Turbocharger to its "water quench" hardened track shoes. It's available with direct drive or torque converter for speeds to 7.8 MPH. Operators report it fast and easy to handle, with hydraulically boosted steering and brakes, "in-seat" starting, and smooth "live shaft" drive for cable controls.

It all adds up to the "workingest" tractor ever built. See your Caterpillar Dealer for details on the D9 with No. 9A or No. 9S Bulldozer blades. And count on him for fast, skilled service and Caterpillar parts you can trust.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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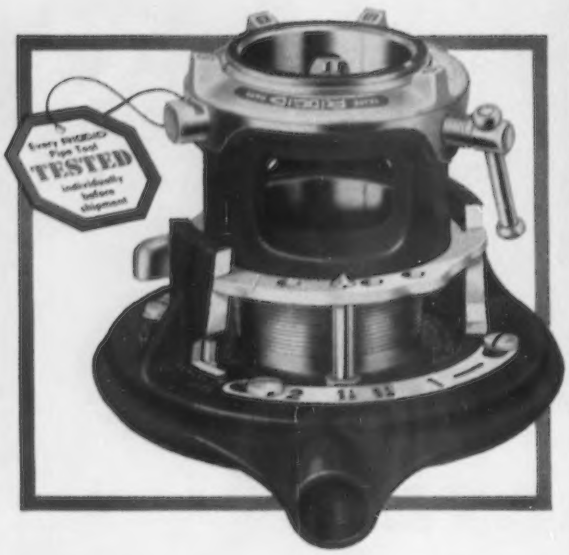
Nearest Thing
to Machine Pipe Threading



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Ready for work fast—you set 65R to pipe or conduit size in 10 seconds . . . self-contained 1", 1¼", 1½", 2" high-speed steel dies. Self-centering workholder sets to size instantly.

No mistakes—automatic kick-out prevents jamming when standard thread is cut. Workholder setting is mistake-proof.

Beautiful threads—perfectly threaded factory test sample in your new 65R proves it!

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NEW
Tee-Cee One-Pass
carbide drill bits

COST HALF THE PRICE OF OTHER CARBIDES . . . HAVE CUT DRILLING COSTS UP TO 75%

HERE'S THE PROOF

RESULTS OF TESTS IN CANADIAN MINES *

MINE TESTS	FORMER COST PER FT. DRILLED WITH OTHER CARBIDES	COST PER FOOT WITH TEE-CEE ONE-PASS CARBIDE BITS	COST SAVINGS PER FOOT	PERCENTAGE SAVING PER FOOT	SAVING ON EVERY 100,000 FT. OF DRILLING
"A"	8.2¢	2.06¢	6.14¢	74.87%	$6,140.
"B"	11.3¢	5.07¢	6.23¢	55.13%	$6,230.
"C"	8.0¢	7.15¢	.85¢	10.51%	$ 850.
"D"	3.2¢	2.7 ¢	.5 ¢	15.6 %	$ 500.
"E"	4.5¢	2.0 ¢	2.5 ¢	55.5 %	$2,500.
"F"	9.6¢	6.3 ¢	3.3 ¢	34.37%	$3,300.

The revolutionary new "Tee-Cee One-Pass" Carbide Drill bit costs less than half the price of other carbides—you drill it to destruction, then throw it away. Tested and proven in 35 Canadian mines, it cuts costs in almost every case . . . up to 75% in one test. The "Tee-Cee One-Pass" carbide bit earns additional savings, too. It eliminates time wasted in transporting worn bits to the surface . . . does away with the cost of grinding time and equipment. Test this bit on your own operation. Write to: Thompson Products Limited, Mining Division, St. Catharines, Ontario, Canada.

New "Tee-Cee One-Pass" Carbide Bit can be used with existing steels. Simply cut off solid carbide tip or thread and forge, grind or machine your steels to an 11 degree taper. New brass shim makes fitting and knock-off easier.

LIDDICOAT Detachable Drill Bits by

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AEC Lets Contracts For Purchases of Zirconium

ANNUAL DELIVERY of 2.2-million lb zirconium is called for in three-year contracts let by the Atomic Energy Commission to Carborundum Metals Co., National Distillers Products Corp. and NRC Metals Corp.

Metal will be used in atomic reactors; the major portion for Navy contracts. Remainder will go to the AEC's reactor or atomic furnace development programs. New contracts will catapult the metal to more than seven times current output. Present production runs about 300,000 lb annually. A drop in price also is foreseen as more material becomes available.

Carborundum Metals, the AEC's current supplier, will provide 500,000 per year from facilities at Parkersburg, W. Va. National Distillers will supply 1-million lb from a 1.5-million lb capacity plant to be constructed at Ashtabula, Ohio. NRC, a subsidiary of National Research Corp., Cambridge, Mass., will supply 700,000 annually from a new plant near Pensacola, Fla. New operations are expected to be in production in 1957. Wah Chang Corp. will operate the USBM pilot plant at Albany, Ore., to provide 300,000 lb a year.

Until production in the U. S. gets rolling, 200,000 lb of reactor grade zirconium will be imported from Japan for the AEC by Commodity Credit Corp.

AEC Bonus Payments Top $7-Million Over 5 Years

UNITED STATES uranium operators have received $7,145,129 in the form of initial production bonuses from the time program started March 1, 1951 to April 30, 1956, according to the Grand Junction operations office of AEC. A total of 3,824 individual payments were made.

Maximum payments for production of 10,000 lb uranium oxide were made to 738 properties.

Last previous report on bonus payments was made by GJOO in April 1955, when the total was $5,001,815, with 2,889 individual payments and 538 properties certified.

Venezuela Finds Bauxite

OFFICIAL confirmation of important deposits of bauxite has been made by government officials at Caracas. Ministry of Mines reports that government geologists have definitely located commercial deposits in various parts of the state of Bolivar in southern Venezuela. Samples are reported to show 40% Al, a small amount of silicon and 27% iron oxide. Estimates range around 10-million tons.

This Mineral Concentrating Efficiency Makes Sense

It's easy to believe you should take a good look at any concentrating process that promises to save money.

When that process assures the utmost in performance efficency, your "look" becomes a "must." Maximum concentrating efficiency at lowest cost is exactly what you get when you employ the SuperDuty® DIAGONAL-DECK® concentrating table.

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CONCENCO PRODUCTS

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AIME Pacific NW Session Attracts 260

HELD MAY 3-5 at Seattle, Wash., the 1956 Pacific Northwest regional conference of the American Institute of Mining, Metallurgical and Petroleum Engineers was attended by 260 institute members from Washington, Oregon, British Columbia, Idaho and Montana. Next year's conference will be held in Portland, Ore.

A feature of the conference was the first Symposium on X-ray Analysis sponsored by the School of Mineral Engineering of the University of Washington. Symposium was devoted to brief discussions of the various techniques utilizing X-ray as an analytical tool in the mineral industry, with demonstrations of equipment.

Speaking before the mining session, J. Frank Ward, managing director of the Washington State Power Commission, predicted that the Pacific Northwest might turn back to coal as an energy source in the near future.

"The trend of power development has been that time and the growth of electric power use have required adding steam generation," Ward said. "The Pacific Northwest approaches that time in its power development experience. This offers hope for development of coal mining in the state of Washington as an important factor in regional power supply."

Delegates heard a talk by James R. Morgan, General Electric metallurgist at Hanford Works, on methods used in examining crystalline structure of irradiated uranium. The structure is etched out by an electrical process, then photographed by a remote metallograph, a microscope-camera.

Thoroughbreds
for your string!

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STEMS

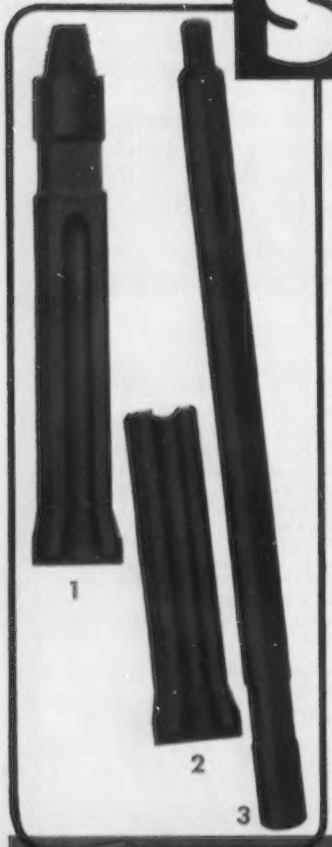
Sure winners in performance and production! Spang Bits and Stems, developed by skilled experts, are a safe bet to pace the field in long service and economy. Win, place or show you can be sure with Spang.

① SPANG CHURN DRILL BITS drill more holes per bit at lower cost! Fully heat-treated, high carbon, molloy steel, or 4340 steel. They have added strength in pin and blade sections to enable them to take the toughest drilling conditions in stride. Semi-dressed ends speed finish-dressing.

② SPANG REPLACEMENT BLADE SECTIONS are for welding to the pin and collar sections of the original bit when it has become worn from long service.

③ SPANG INTEGRAL ROPE SOCKET TYPE STEMS with heat treated swivel socket and swivel. Drill more . . . drill longer for less with these rugged, efficient stems. Made from one bar of steel with only a threaded box joint with integral rope socket top the stem's uniformity cuts vibration or whipping. Tools turn freely in the open swivel socket keeping the hole round and straight.

Your inquiries are welcome— contact your nearest Spang dealer or write direct to:



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IN THE U. S.

ALASKA

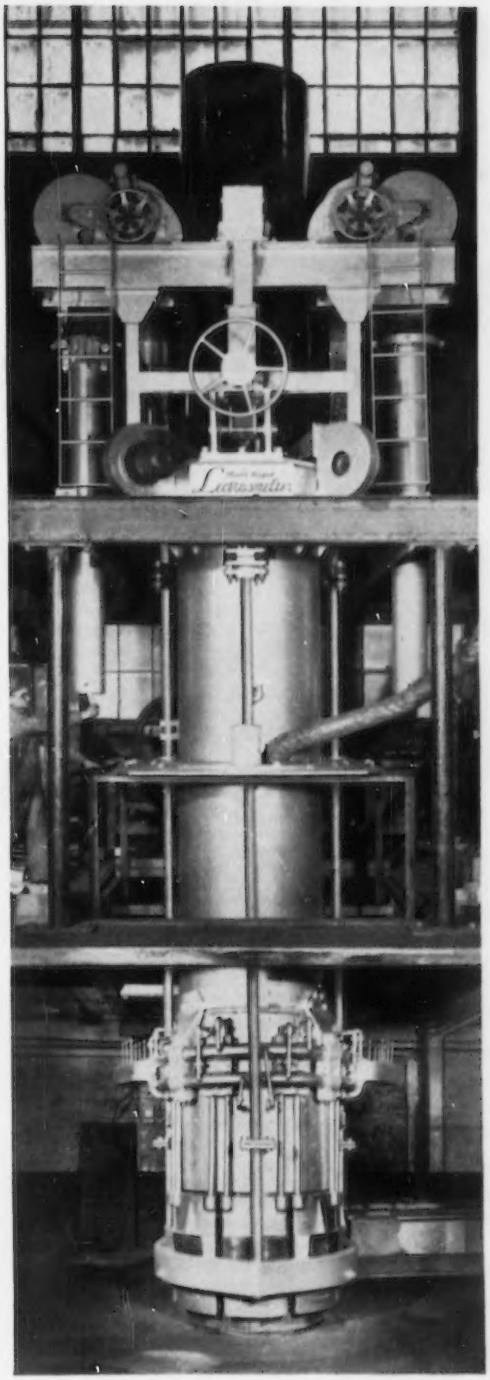
Development of the well-known Klukwan iron ore deposit near Haines is a step nearer as a result of an agreement finally reached between the Klukwan Indian village and Klukwan Iron Ore. Corp., a subsidiary of Quebec Metallurgical Industries, Ltd., of Toronto. The stumbling block has been a 320-acre administrative site set aside by the Government which the village did not, until recently, wish to lease to the company. Carl Heinmiller of Port Chilkoot and Phil Holdsworth, Commissioner of Mines, assisted in the negotiations. The next step is for the interested parties to have the administrative site abolished and added to the Indian village reserve by Congressional action.

New placer operation on Slate Creek in the Upper Chistochina area is that of Hobb Enterprises, Inc., of Spenard. Equipment taken in to the property includes three D-8 bulldozers and a dragline in addition to smaller equipment and supplies.

Alaska's biggest gold producer, U. S. Smelting Refining & Mining Co., will be operating in three widely separated sectors of the territory this year. In addition to its regular dredging work in the Fairbanks and Nome areas, the company hopes to get a dredge in operation on the Hodgatza (Hog) River ground which they purchased last spring. More than 1,500 tons of equipment, which included a 1,000-ton dredge, were carried 880 miles by river last summer to the inlet of the Hodgatza River on the Koyukuk River. This spring, crews moved the dredge overland 20 miles to set it up. J. D. Crawford, manager and vice president of the USSR&M denied that the company expects any bonanza at Hog River in answer to widespread rumors concerning the claims. He admitted there are two creeks which "look good" to them, however.

Fairbanks Exploration Company, a branch of USSR&M, will operate six dredges within a 20-mile radius of Fairbanks this season. They will also restore a seventh dredge which has been inoperative since 1949 to take out some lower grade ore at Chatanika.

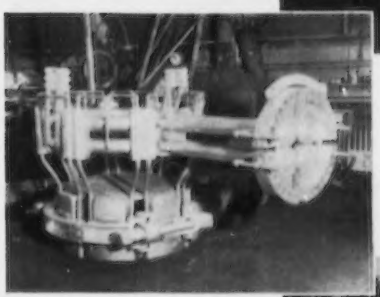
Two dredges were to get into operation at Nome by June 1 and a third before the end of the summer. It will consist of a new hull to house the mechanical portions of a dredge which



These features help make Lectromelt* Furnace Equipment popular all over the world

LECTROMELT furnace equipment for smelting and refining work is described in Catalog No. 105. For a copy and for help in selecting this equipment, write Lectromelt Furnace Company, 322 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

◀ *Lectromelt builds complete self-baking electrode assemblies. Here you see one of fifteen supplied for a domestic smelting installation, assembled on our erection floor for testing. These assemblies handle 40-inch self-baking electrodes.*



▲ *24-inch power-operated electrode clamps.*

◀ *40-inch Lectromelt electrode clamp, built to our customer's space requirements.*

Lectromelt bus bars are assembled in our plant to assure that they fit accurately when erected at your furnace. ▶

Manufactured in . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa . . . JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF.

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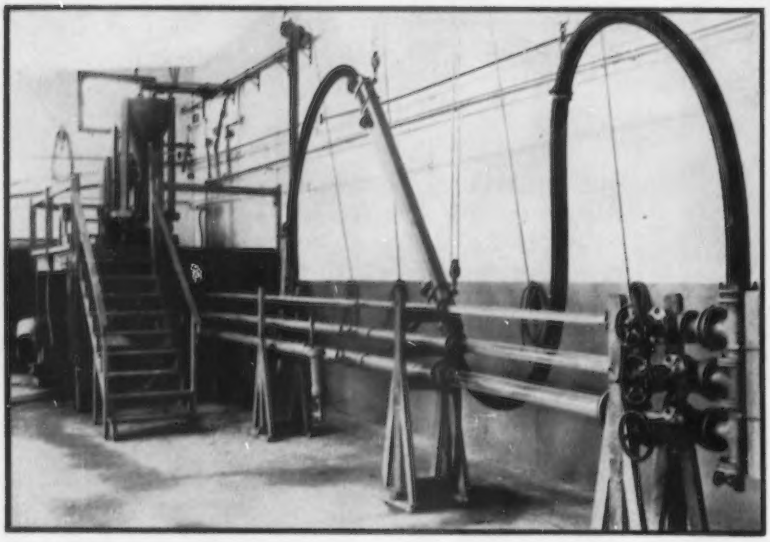
WHEN YOU MELT... Lectromelt

MORRIS Pump Performance is *insured in advance* in this modern slurry laboratory!



The Morris equipment testing slurry shown here can determine friction losses and critical carrying velocities of any slurry. Customers' samples analyzed here have taken much of the guesswork out of slurry applications, and yielded such answers as these to actual pumping problems:

ANSWER	1	Proved that a job originally estimated at 200 HP could be done easily with 60 HP — because of very low critical carrying velocity and unusually low friction loss.
ANSWER	2	Proved wide friction differences in very similar materials — saving the customer the time, expense and possible loss of an inadequate pump.
ANSWER	3	Proved that the customer could handle the job by gravity alone — and so required no pumping equipment at all!

GOT A SLURRY PUMPING PROBLEM? For quick action, get in touch with the Morris engineers. The answers turned up by the Morris Slurry Laboratory may be just as pleasantly startling as any of the three above. If the pipeline is long, the Morris laboratory may give you the answer for minimum friction loss. A Morris-engineered installation is your best bet for economical, trouble-free service.

MORRIS CENTRIFUGAL PUMPS

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

Alaska *(Continued)*

sank three years ago when the 20-year old wooden hull sprung a leak and capsized.

ARIZONA

Utah Southern Oil Co., Salt Lake City, has made a token, 40-ton shipment of uranium ore from properties in the Cameron district to the Tuba City mill of Rare Metals Corporation of America.

DeWitt Van Evera, Salt Lake City, mining engineer and treasurer of Utah Southern, prominent mountain area independent, said the shipment was made merely to test amenability of the ore.

He said that "if we have a mine, it will be a small one."

Pima Mining Co. of Tucson, Ariz., currently is taking deliveries on 11 rock and ore movers manufactured by the Kenworth Motor Truck Co. of Seattle. It will use them in the production of copper ore at an open-pit operation, in connection with a rockover skip system fabricated for Pima by the National Iron Co. of Duluth, Minn.

The trucks are all spring-mounted, end-dump units powered with 300-hp turbocharged Cummins industrial-duty engines.

Seven units have torqmatic drives and will be used in the mine pit, hauling ore and waste to the skip-loading pocket at different benches. Four tractor-semi-trailer units, with a capacity of 48 tons or 32 cu yd, will haul ore and waste from the bins in the headframe incorporated in the skip system.

Edward Arthur, mining commissioner of the Los Angeles Chamber of Commerce, is conducting a personal survey of mining operations in Arizona and southwestern New Mexico in order to aid Los Angeles County firms in facilitating the flow of mining materials to the metropolitan area. Arthur's findings will be published in a statistical report on the value of metal production in the southwestern mining areas.

International Metals, Inc., plans expansion of its tungsten plant at Douglas to produce three tons daily. The facility will be used to produce tungsten in an almost pure state for industrial uses. Company now processes tungsten ore mined in Sonora, and Baja California, Mexico.

CALIFORNIA

Uranium activity has picked up in the San Bernardino County portion of the Mojave Desert, with at least two promising finds have been reported in the Twentynine Palms area.

Exploration and evaluation are under way at both sites.

Morath Co., Los Angeles, is reported to have found a small amount of pitchblende near the surface of its Ram

Compact Cleveland Speedaire on winch which hoists equipment. Photos courtesy of Ellicott Machine Corporation, Baltimore, Md.

All over the world, SPEEDAIRE drives winches on Ellicott dredges

USED for harbor improvement, land reclamation, sand and gravel production and other dredging jobs, Ellicott dredges are known throughout the world. Their reputation is one of quality. This starts with the components parts of Ellicott dredges and dredging machinery, an important one being the Cleveland Speedaire Drive. Used to operate the hauling and hoisting equipment, the Speedaire transmits power smoothly and without interruption. It takes little space and weighs much less than a conventional drive. It continues its economical operation year after year. In fact, Cleveland case-hardened steel worms and nickel-bronze gears actually improve with use—will be even more efficient many years from now.

Investigate what Speedaire and other type Clevelands can do for your operations. Catalog 400 gives the complete story. Write for your free copy today. The Cleveland Worm & Gear Co., 3281 E. 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

California (*Continued*)

claims in the Twentynine Palms area.

In the Amboy area northeast of Twentynine Palms, New Method Mining Co., Amboy, is said to have uncovered a prominent vein with flourite and uranium present in it.

A group of Taft prospectors is stockpiling low-grade uranium ore preparatory to making a shipment from claims on Midway Peak in the Temblor Range, Kern County. An upgraded sample of ore from the claims assayed high, according to L. L. Curyea, spokesman for the group. Operation is open-pit, with prospectors using a small mill to pulverize ore and a mud shaker attached to a cement mixer for the concentrate that is being sacked.

New Idria Mining and Chemical Co., one of the nation's top quicksilver producers, has purchased Laan-Tex Oil Corp., Dallas, Tex. and Beaver Petroleum Corp., Wilmington, Del.

The transaction, which advances the New Idria, Calif., firm's diversification aims, is subject to approval of New Idria stockholders, who are slated to vote on the proposal at a special meeting in mid-June.

New chrome mill was scheduled to begin operation June 1 at Goldtree Siding, 4 miles north of San Luis Obispo, on the Southern Pacific Railway. Castro Mining Co. is building the mill which will treat ore from the Castro Mine and other chrome mines in the district.

Mill was purchased from Vernon James of Atascadero, is being remodeled and moved from its former location on the Froome property 44 miles west of San Luis Obispo to its new location.

New mill will have a capacity of 75 tpd. It will be on the same site as the concentrator formerly owned by Castro Chrome Associates which produced 26,000 tons of chromite concentrates from the Castro mine from 1942-1945.

Castro Mining Co., headed by Durand A. Hall of San Francisco, holds a long term lease on the Castro Mine 9 miles north of San Luis Obispo. Ore consistently averages slightly more than 24% Cr^2O^3 and produces a concentrate averaging 44% Cr^2O^3 with a Cr:Fe ratio of 2.5 to 1, it is reported.

All ore to date has come from open cuts. Mining is done by shovel-loader. Ore is loaded directly into trucks and hauled to the mill. Concentrates will be loaded directly from the mill into ore cars and shipped to Grants Pass, Ore., stockpile of General Services Administration.

Idaho Maryland Mines Corp. has placed its new tungsten mill in operation at Grass Valley.

The $25,000 facility has a capacity of 75 tons per 24 hr. It is being operated currently at rate of 50 tpd—two 8-hr shifts.

The mill utilizes a crushing plant that was already in operation. New features of the 3x8-ft rod mill are four concentration tables, a flotation cell, and a cleaning table.

The mill is producing 50-60% concentrate. Concentrate is shipped to the Tulon mill near Lovelock, Nev., for upgrading to 70%.

Idaho Maryland has been shipping tungsten concentrate to the Government's buying depot in San Francisco.

Company president Bert Austin said a project under consideration is dewatering of the Union Hill shaft at Grass Valley. The 1,200-ft shaft is part of a gold mining operation that has been idle since 1920.

The Union Hill shaft can be used for working tungsten deposits. Decision on the dewatering project rests on outcome of a diamond drilling program now under way and an application for a $244,000 DMEA loan.

In charge of the mine and mill operation is Max Bechhold, resident manager.

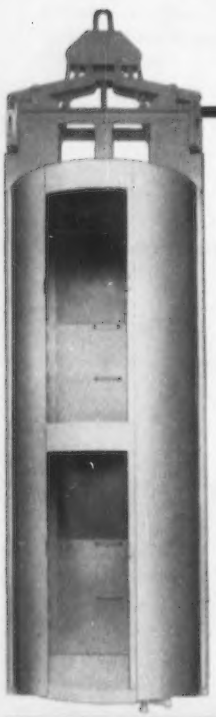
COLORADO

Ventilation is inadequate in most uranium mines on the Colorado Plateau, Duncan A. Holaday of the U. S. Public Health Service in Salt Lake City told a health conference in Denver in April.

The conference was called by the Colorado health department to hear reports on a 5-year study of uranium mining health problems.

Holaday advised that uranium mines

WHICH MINER WOULD YOU HIRE?



Naturally you would hire the whole man—even so, are you getting the most productive man hours from your section crews? . . . or are your men losing too much time traveling between the lamp house and the face? If the answer is "yes" then let us show you how you can quickly and reasonably install a speedy, safe Connellsville Automatic Man Cage nearer the face—a portable installation which can be moved to a new location, when necessary, with a minimum of time and expense. This man cage will cut travel time up to 50% per man—a big savings in time—a big boost in production when multiplied by individual crew members.

Custom-built to meet your requirements, the two-deck Connellsville Elevator-type Man Cage is fully automatic with push button controls. Installed complete with hoist, controls, counterweight and sheaves at a price lower than conventional methods and equipment.

Literature on request—write or call today.

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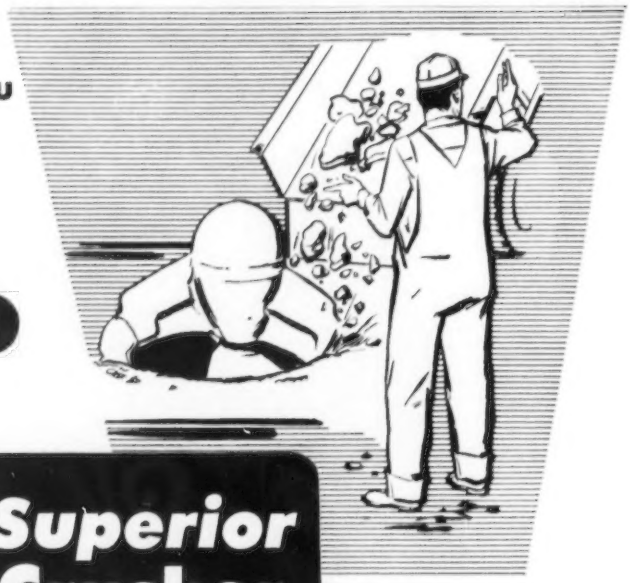
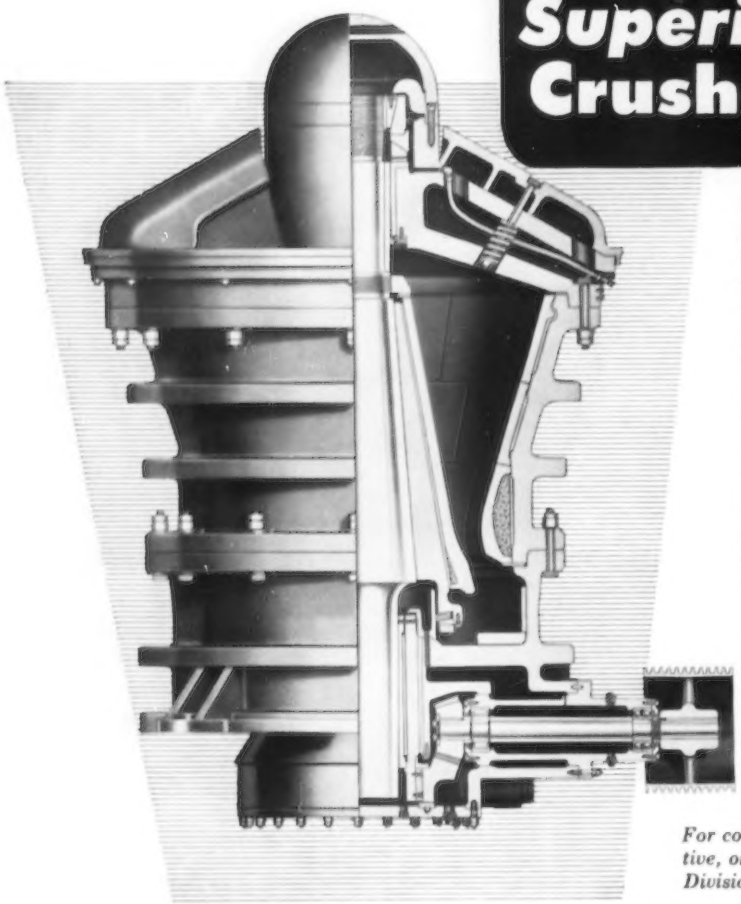
Only one crusher gives you

Complete Adaptability for a BALANCED CIRCUIT



Superior Crusher



• With a *Superior* gyratory crusher pacing production, your entire circuit remains in balance. Subsequent equipment—crushers, screens, grinding mills—need not be readjusted to varied product sizes and capacities. The many variable factors provided by the *Superior* crusher permit obtaining the kind of production flow demanded by your other equipment. For example, changing eccentric throws, crusher speed or shape of crushing chamber varies capacity and product size. The *bottom discharge* permits utilizing the concrete foundation as a surge bin to control flow of material through your plant.

Hydroset control is another factor in maintaining a balanced circuit. Retaining the initial crusher setting by compensating for wear is a one-man, one-minute operation when a *Superior* gyratory crusher is so equipped. Emergency unloading is made easier with just the flick of a switch. A-4934

For complete information, see your A-C representative, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis., for Bulletin 07B7870.

Superior and Hydroset are Allis-Chalmers trademarks.

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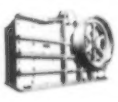
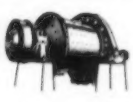

Jaw Crushers

Gyratory Crushers


Grinding Mills

Kilns, Coolers, Dryers

Colorado *(Continued)*

should have enough artificial ventilation to change the air at working faces every 4 to 10 minutes.

Plans for a $660,000 expansion program at the AEC's Grand Junction operations office were disclosed in April. Project calls for enlarging the concentrate sampling plant and the analytical laboratory, and bids were to be asked in the "very near future." AEC said increased ore and concentrate production made the expansion necessary.

Cost of the American Gilsonite Co.'s new processing plant near Fruita will exceed $12-million, president E. F. Goodner said at a Fruita Chamber of Commerce dinner in April.

Over-all expenditure in the company expansion program, including opening of new shafts at the Bonanza, Utah, mine; construction of a pipeline from Bonanza to Fruita, and the Fruita refiners, will exceed $16-million.

About 300 men now are employed in construction, Goodner said. Completion of the refinery is expected in 1956.

At Idaho Springs, Sarstark Mining & Exploration Co. has taken a lease on a 25-ton mill in Trail Creek canyon and will go into 24-hr a day operation, milling ores from the company's holdings in Virginia canyon and Kremmling area. Sarstark Mining & Exploration Co. is backed by a group of St. Louis business men. Stanley Hill, veteran Clear Creek County miner and assayer, is supervisor of the company's operations here.

Raymond O. Richard, president of Three Forks Oil & Uranium Co., Inc., with headquarters at Steamboat Springs, says, "We have shipped our pilot load of uranium ore from our Rainbow Group of claims located 20 miles south of Grand Junction to the Climax Uranium Co. mill at Grand Junction."

American Leduc Uranium Corp. has obtained for a consideration the reassignment of a Crescent Uranium Co. lease on 21 Outlaw Mesa claims, which are part of Leduc's 2,000-acre property in Mesa County.

Leon Henderson, president of American Leduc Uranium, announced that the two Peach mines, formerly operated by Crescent, will be expanded by Leduc to include the mining of recent ore discoveries on its main property and on the recently acquired Blue Creek claims.

"Base metal mining is looking up at Lake City," says Frank M. Mendenhall and J. R. Pray who have leased the Pelican mine after being shut down for over 40 yr. They have opened a 20-in. streak assaying 1 oz gold and 100 oz silver, and are now sending their third shipment to Leadville. Also Joel Swank has done extensive development work on his Black Crooke lease. Now with uranium in sight there should be quite a mining boom at Lake City.

Phil-Mar Co. of Fort Morgan announced in April discovery of a major strike of beryl ore, and possibly a rich deposit of uranium, near Estes Park. A three-ton load of beryl from the 8-claim property brought $500 a ton, said secretary-treasurer John Phillips.

Beryl was found while stripping overburden to uncover an indicated uranium vein.

Front Range Mines, Ltd., at Cripple Creek has been mining the Strong mine claims on a lease basis. In a deal in Cleveland, Ohio, Front Range purchased the mine for $574,000 in cash and stock. One of the big gold strikes in the history of Colorado and the Cripple Creek district has been made at 2,100-ft depth in the Strong mine within the city limits of Victor. This is a mine which, since its discovery in 1893, has produced an estimated $27.8-million in gold. Settlement sheets from the Golden Cycle Corp.'s Carlton mill at Cripple Creek show that one recent lot shipment of ore from the Strong had an average of 17.9 oz of gold a ton.

Reynolds Minerals Corp. has begun driving an 810-ft extension to the 1,400-ft prospect tunnel at Nederland in accordance with its contract with the Defense Minerals Exploration Administration. The tunnel is aimed at exploring the extensions of such tungsten producing veins as the Spencer, Forest Home, Cold Spring and Hoosier in the Hurricane Hill area. Hurricane Hill is a timbered and heavily

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VERSATILITY AND RUGGEDNESS: This barrel will core with water, mud or air. It's built with heavy wall tubing—hard faced head—heavy back end, and outer tube threads. Oversized bits may be used.

ADJUSTABLE INNER TUBE: To regulate the force of the fluid at the mouth of the bit and to reduce the interval in which the core is subject to wash by the circulating fluid.

FLUID LUBRICATED BEARINGS: No grease packing every time you cut a core—the bearing is lubricated by the water or mud circulated.

STABILIZED INNER TUBE: No core lost because of friction grinding.

SKIRT TYPE CORE SPRING: Tilting or cocking of core spring is eliminated. No core loss due to grinding, blocking or core wash.

SIZES: AX . . . BX . . . NX.

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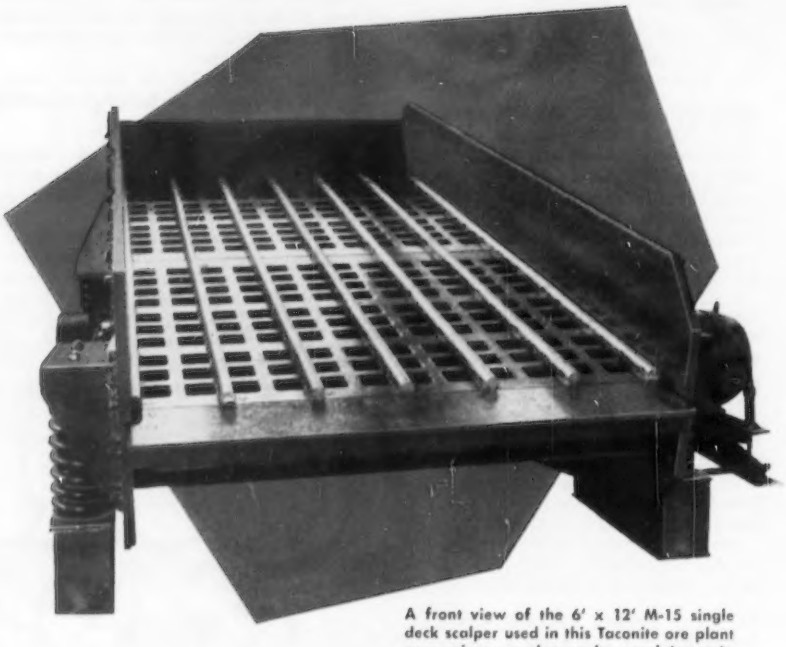
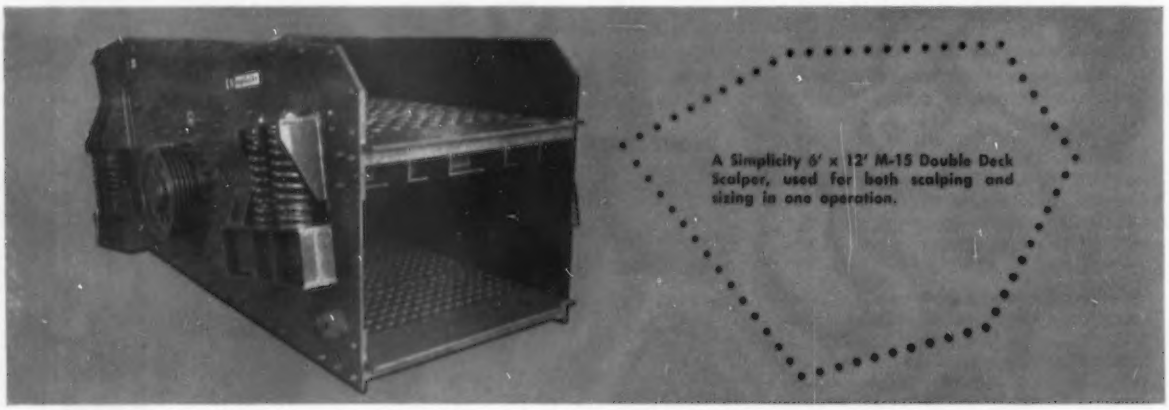
1937 SOUTH 2nd WEST • SALT LAKE CITY, UTAH

430 long tons per hour of Taconite ore handled by this SIMPLICITY scalper



A front view of the 6' x 12' M-15 single deck scalper used in this Taconite ore plant as a primary and secondary scalping unit.

Lumps up to 24" of hard, tough, extremely abrasive Taconite ore are scalped by this Simplicity 6' x 12' Model M-15, at a throughput rate of 430 long tons an hour. This primary scalper is accompanied on the job by six other heavy duty Simplicity units, all of them, of course, handling the same gruelling fast flow of Taconite. First operation in the Taconite processing is feeding the ore to the primary scalper: this is done by a Simplicity 6' x 16' Model MA Feeder. Large chunks are fed off the 6' x 12' single deck M-15 primary scalper onto a Simplicity 6' x 20' Picking Table, where all obvious shale, stone, and other foreign material is removed. From here, the ore is put through a jaw crusher, and from the crusher two Simplicity 5' x 20' Feeders set in tandem deliver it to the secondary scalper. This unit, like the primary, is a Simplicity M-15 6' x 12' Heavy Duty Scalper. Fines from this operation now go to a Simplicity Double Deck 6' x 12' M-15 Scalper, where they are both scalped again and graded. Larger lumps are fed through a cone crusher, then they are likewise scalped and graded. The ore is now ready for extraction. This whole plant is set to work 24 hours a day seven days a week . . . and the rugged Simplicity equipment assures that down time will be negligible. Write today for details of Simplicity units for your own operation.



A Simplicity 6' x 12' M-15 Double Deck Scalper, used for both scalping and sizing in one operation.

180

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IT pays to switch bit types as the ground changes. The most economical way to do this is to use Timken® carbide insert and multi-use rock bits. In less than a minute, drillers can unscrew one type of Timken bit and screw on a different one—right on the job. No time wasted going after another set of drill steels. No need to stock expensive double inventories because dozens of Timken carbide insert and multi-use bits are interchangeable on the *same* drill steel.

When you use Timken interchangeable rock bits, you know your drillers will always have the most economical bit for the ground being drilled—Timken multi-use bits for ordinary ground, Timken carbide insert bits for hard, abrasive ground.

Both of these Timken rock bits give you two important advantages: 1) they are made from electric furnace Timken alloy steel, 2) a special shoulder union keeps drilling impact from damaging threads.

Our rock bit engineers may be able to help you with your drilling problems. They're experts in cutting drilling costs. There's no obligation. Write The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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Most economical for ordinary ground. With correct and controlled reconditioning, they give lowest cost per foot of hole when full increments of steel can be drilled.

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Colorado *(Continued)*

overburdened area in the midst of the well-known Boulder County tungsten district.

Two hundred and twenty-three tons of ore assaying 0.66% uranium oxide and 2.31% vanadium were shipped in the last two weeks of March from Lakeside Monarch Mining Co.'s Badger mine on Martin Mesa, Montrose County. Total settlement for the two-week period was $17,144, said general manager Robert E. Mohler of Moab, Utah. Badger is being worked with a 5-man crew.

IDAHO

Highland-Surprise Consolidated Mining Co. has taken over exploration of the old Copper Camp properties in the Big Creek District of Valley County under perpetual lease agreements and will fly in the necessary crew and equipment for a complete survey and geological examination. A preliminary inspection last October disclosed a number of parallel iron-copper vein outcrops, and seven samples taken at the time ranged from a little over 1% to more than 7% copper.

Lease agreements provide for a 10% royalty on the first $60,000 of production, 8% on the next $60,000 and 5% on all production over $120,000.

At the Deer Trail property in the Stanley Basin of Custer County, the first five months of exploration work have indicated five ore zones containing between 110,000 and 130,000 tons ore reserves. Exploration efforts this year will be designed to open the projected southerly extension of the vein in the hope of developing sufficient additional reserves to justify installation of concentrating facilities at the isolated camp. Sunshine Mining Co. has a 50% interest in the Deer Trail venture.

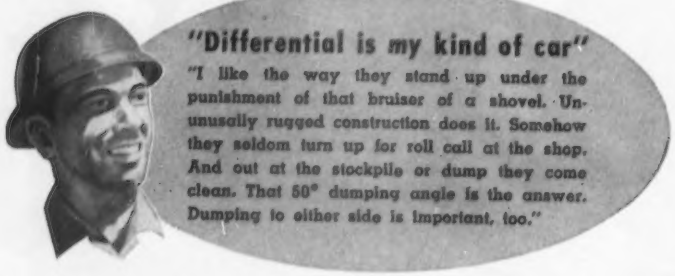
Old Black Bear Mine on Canyon Creek northeast of Wallace, which has been a sporadic lead and zinc producer for many years, is again in production from two stoping areas under operation by Metropolitan Mines Corp. Current production is being stockpiled for later milling at the nearby Hull Lease mill. Metropolitan has an agreement to acquire stock control of Black Bear Silver-Lead Mines, which has a 12-year lease on the mine.

Clayton Silver Mines has opened the big North orebody on the new 550-level at its Bayhorse District property in Custer County, adding a potential six years of ore reserves, at present mill capacity, if the ore shoot proves no smaller than on the 400 level above.

Polaris Mining Co.'s East Exploration lateral from the 3,000-ft level of the Silver Summit shaft in the Silver Belt of the Coeur d'Alene District is now beneath Rainbow Mining & Milling Co. property, more than 9,000 ft east of the shaft, and has been angled northeasterly toward the geologically-favorable footwall area of the major Polaris fault. Increased ground-fracturing is being encountered, with numerous seams of siderite gangue carrying pyrite, chalcopyrite and tetrahedrite mineralization, it is reported. Objective area of the project, which is being done under a DMEA contract, is expected to be reached within the next few months.

Hall Mountain Thorite Co. has resumed development work at its five-claim thorium prospect in Boundary County near Porthill, after a brief winter shutdown. Surface exploration work last year uncovered a radioactive vein which assayed 3.2 to 7.9% thorium, with minor zirconium and uranium oxide values, and initial work this year will consist of bulldozer trenching along the vein outcrop to define the structure and provide additional geological information.

Sunshine Mining Co. has started deepening two compartments of its main four-compartment Jewell shaft on Big Creek west of Wallace to gain depth on Silver Syndicate's West Rambo orebody which lies a few hundred feet to the north. Initial leg of the sinking will be to the 4050-ft level, and a new 4000-ft level will be established. Orebody has been largely mined out down to the 3840-ft level, and the deeper workings are expected to overcome the ore depletion problem which resulted in Silver Syndicate's net loss for 1955.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"I like the way they stand up under the punishment of that bruiser of a shovel. Unusually rugged construction does it. Somehow they seldom turn up for roll call at the shop. And out at the stockpile or dump they come clean. That 50° dumping angle is the answer. Dumping to either side is important, too."

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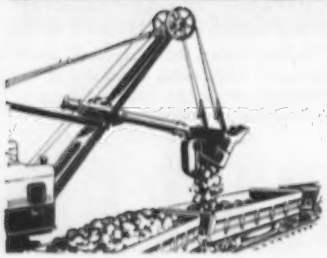

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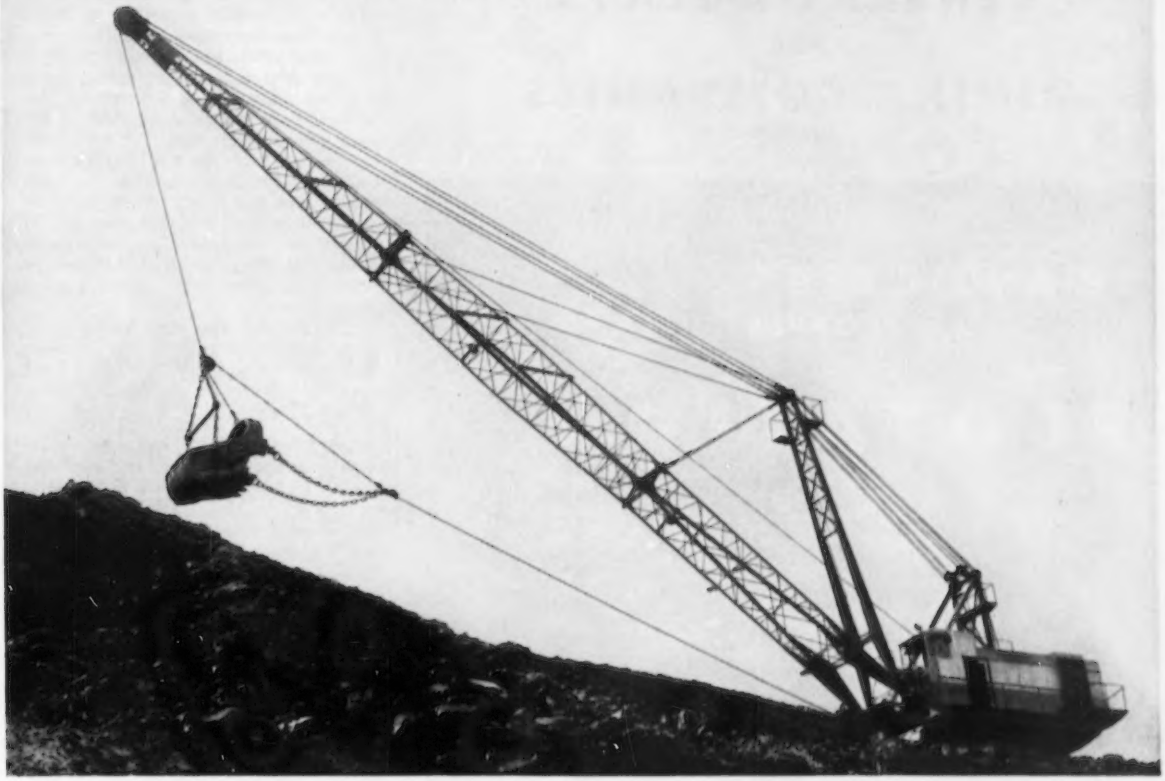

57% Longer Life with New VHS Dragline

Draglines take a real beating in the coal stripping operations of the C B & M Coal Company, Plains, Pennsylvania. Used for removing over-burden, the best Improved Plow Steel draglines lasted 525 hours. When new TRU-LAY VHS draglines were used they established service records of 825 hours—57% better than Improved Plow Steel.

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VHS is setting similar service records on Draglines all over the country. Made from a new grade of steel for wire rope, new VHS is at least 15% stronger than Improved Plow Steel, the strongest grade available before VHS. This means you can handle heavier loads with the same diameter line. And you get a higher factor of safety.

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New VHS is also tougher . . . resists abrasion . . . cannot become "hide-bound" or lose its flexibility. Developed especially for use as slusher ropes, draglines, shovel hoist ropes, and winch lines, it stands up better in these toughest services.

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In addition to longer life, new VHS cuts costly "down time" of equipment for wire rope replacement. This can mean savings.

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Your American Cable distributor has draglines, slusher ropes, shovel hoist ropes, and winch lines of new VHS in stock now. Just call him and tell him the size and length you want. You don't need any complicated specifications.

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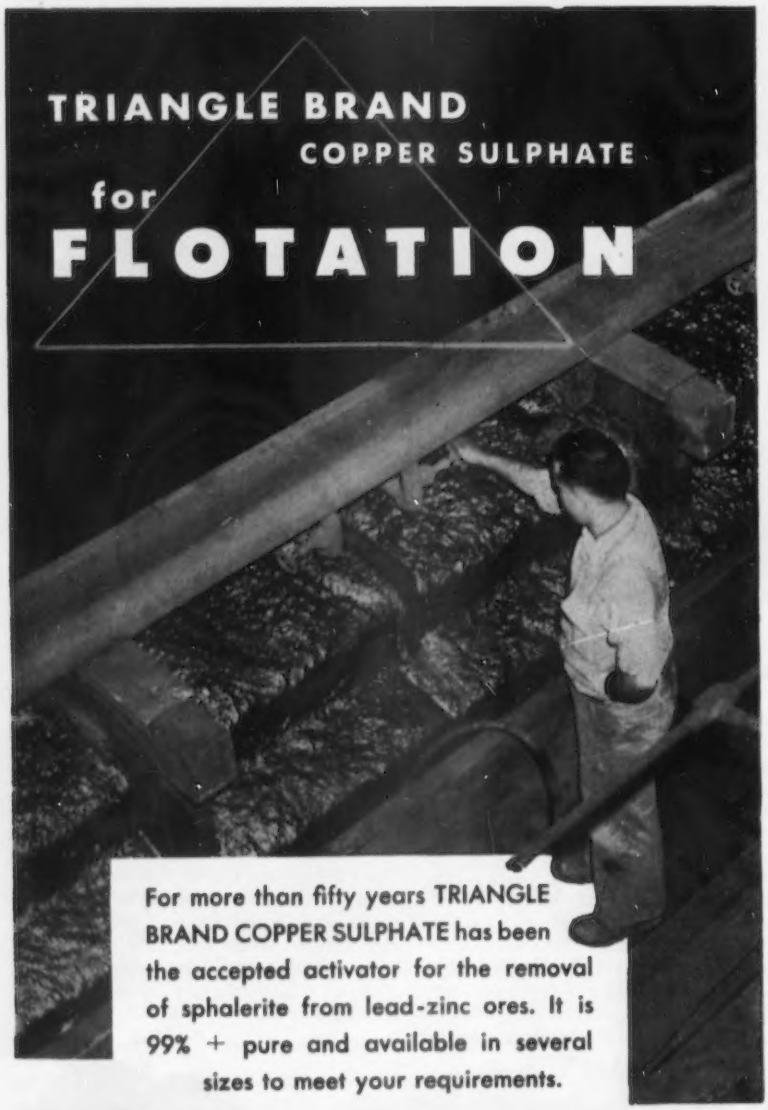
MINING COMPANIES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For more than fifty years TRIANGLE BRAND COPPER SULPHATE has been the accepted activator for the removal of sphalerite from lead-zinc ores. It is 99% + pure and available in several sizes to meet your requirements.
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Idaho (*Continued*)

An offset segment of the big silver vein at the Galena Mine west of Wallace has been picked up on the new 2200-ft intermediate level beyond a fault which had apparently terminated the structure. A north crosscut heading to connect the level with the Callahan winze broke into the ore about 15 ft north of the fault, indicating only a minor offset. The first 35 ft of advance along its northeasterly strike showed an average width of about 8 ft, of ore comparable in grade to that south of the fault. Full length of the offset segment remains to be determined, but it will add materially to reserves on this horizon, since the ore shoot south of the fault was relatively short.

The rich silver vein has been found to lengthen with depth, and on the new 3400-ft level has been exposed for more than 800 ft, with the west face still in ore. Values have also been improving with depth, and the grade on 3400 averages better than 50 oz silver and about 1.7% copper per ton.

American Smelting and Refining Co. operates the mine under a profit-sharing lease agreement with Vulcan Silver-Lead Corp. Day Mines Inc. has a 25% interest in the lease.

Nabob Silver-Lead Co. has nearly completed preparatory work and will soon start sinking an incline shaft on the orebody exposed several years ago in the D-5 vein on the main haulage level at the company's property in the Pine Creek area of the Coeur d'Alenes. A DMEA contract is expected to be negotiated for the project.

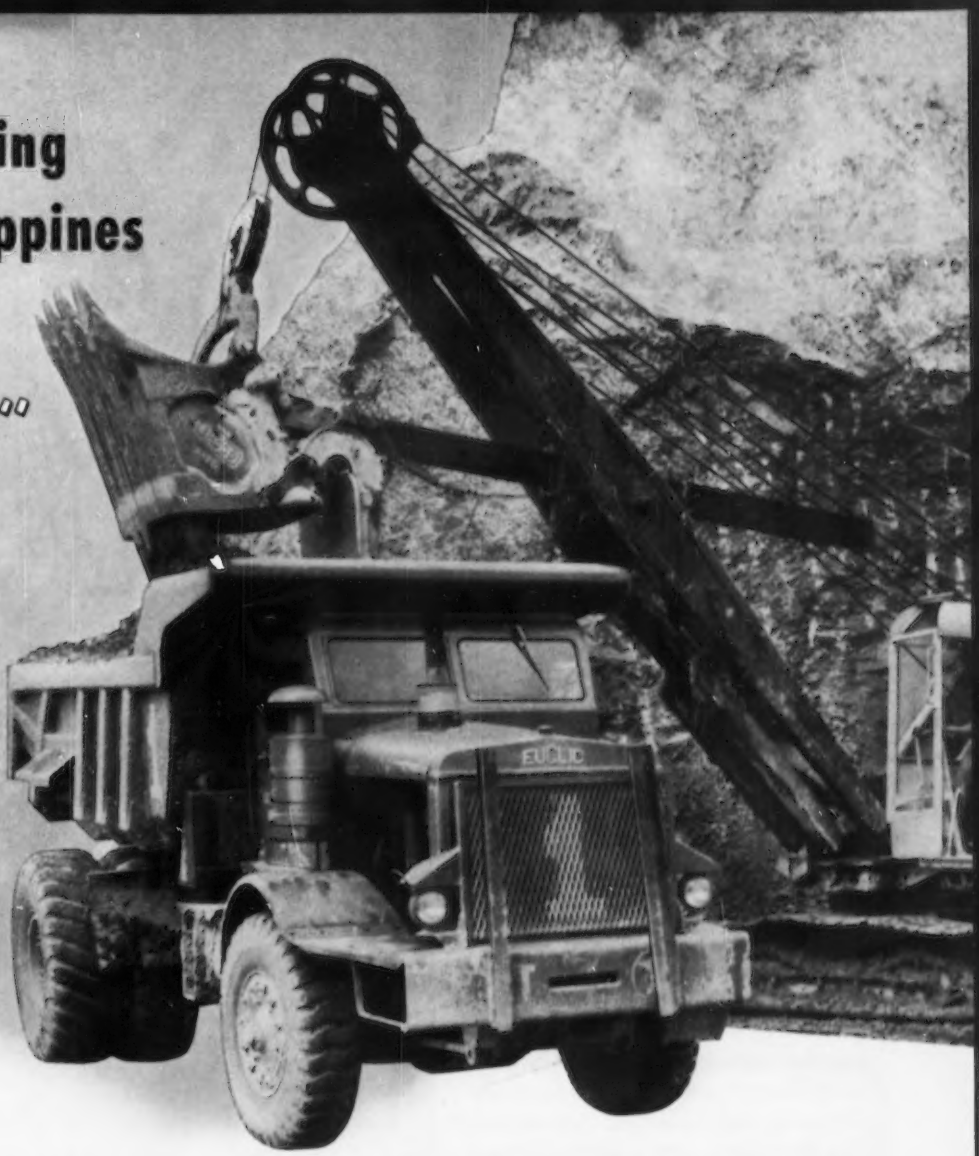
The incline will follow the vein on its 70 deg southerly dip for about 250 ft and a working level will be established at the 200-ft horizon, the deepest tested by drilling. Exposures on the 500-ft-long orebody on the adit level and cores from the down-hole drill tests indicate that the ore will average about 20% combined zinc and lead, with a 2½-to-1 zinc-to-lead ratio and about 3 oz silver to the per cent of lead.

MINNESOTA

The 1956 iron ore shipping season opened April 5 for both Oliver Iron Mining Division and independent mining company mines. The early opening was due to the heavy demand for ore at steel plants which had been operating at near capacity since the 1955 season shipping ended. The Mahoning, Hull-Rust, Sherman group, Hanna Co. mines, Jones & Laughlin properties, Republic Steel and Cleveland-Cliffs Iron Co. mines were among the many that got away for an early start. First cargo of taconite concentrate pellets from Reserve Mining Co.'s plant at Silver Bay began loading April 6 when the C. L. Austin—a 10,800-ton boat—arrived. The pellets came from a stockpile of nearly 1-million tons accumulated during the winter months. The Wilfred Sykes, with M. A. Hanna Co. ore., was the first boat loaded at Great Northern's Allouez, Wis., docks.

(*Continued p 148*)

Copper Mining in the Philippines with "Eucs"



Two Rear-Dump Euclids of 22-ton capacity deliver 6000 tons of ore per day to the crusher . . . six others haul overburden to waste areas.

The new Toledo Mine of Atlas Consolidated Mining & Development Corp. on the island of Cebu is the largest open pit copper mine in the Orient. First ore was delivered to the crusher in early 1955 and operations are now being expanded to more than double the original milling capacity.

Atlas selected 22-ton Rear-Dump Euclids to handle the bulk of the overburden and ore hauling. Two of them supply the mill with about 6,000 tons of ore per day, hauling an average of 1600 feet from the loading shovel. Six of the "Eucs" move overburden out of the pit to waste dumps from 1500 ft. to 1½ miles away.

With 300 h.p. diesel engines and Torqmatic Drives, these big Rear-Dumps have plenty of power to move capacity loads over steep grades and tough haul roads. They've kept hauling costs below original estimates and have proved their workability so well that the company is adding eight more 22-ton "Eucs" to the original fleet.

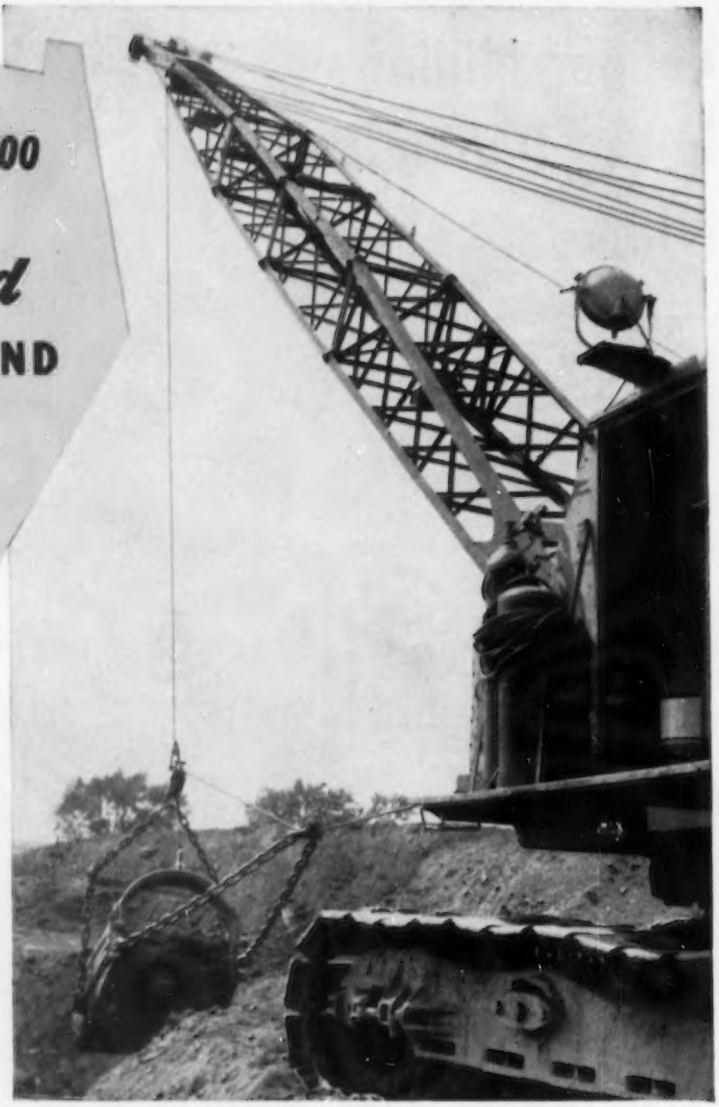
Dependable performance and simple, rugged construction are mighty important considerations when choosing haulage equipment for remote locations like this mine in the Philippines. Excessive down time would seriously curtail production—or even result in a complete shutdown of operations. Have your Euclid dealer show you performance data on mine and quarry work similar to yours and you'll find that ***Euclids are your best investment.***

EUCLID DIVISION, GENERAL MOTORS CORPORATION, Cleveland 17, O.

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE

FIGURE PROFIT HERE, TOO WITH Yellow Strand FLATTENED STRAND WIRE ROPE



You count on track-type tractors, shovels and other equipment for profits. But what about wire rope? You can also figure higher profits by using longer life, more serviceable wire rope.

Yellow Strand Flattened Strand is formed of high quality strands laid up in triangular form (see below) which give you greater contact area that spreads the load over more of the surface. This reduces wear and gives your rope longer life. You get 10% greater strength; you get a wire rope that many owners report lasts up to twice as long as ordinary rope and significantly reduces wear on sheaves and drums. And because it lasts longer, Yellow Strand Flattened Strand saves you much of the time and money lost in frequent rope changes.

So, get Yellow Strand Flattened Strand for longer life, and increased profits. See your Broderick & Bascom Distributor.

COMPARE *Yellow Strand* FLATTENED STRAND

with ordinary (at right) wire rope. In Flattened Strand you have twelve contact points, greater contact area, smoother surface, less wear.

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American Logging Tool Corporation is a subsidiary of Broderick & Bascom Rope Co.

Traylor's Long Experience Building Gyratory Crushers is Your Short Cut to Profits

More than a half-century of experience is reflected in the outstanding design features of a Traylor TC Gyratory Crusher.

The proven production ability of a TC is due mainly to the unique design of its bell head and curved concaves. The design of Traylor original curved crushing surfaces utilizes the full force of the power applied to quickly crush the material as it enters the crushing chamber. And, because each zone in the crushing chamber has greater capacity than the preceding zone, choking seldom occurs.

With these factors combining to eliminate power waste and to assure continuous high output, a Traylor TC is your shortcut to profitable crusher operation.

Traylor TC Gyratory Crushers are built in seven sizes with feed openings from 20″ to 60″ . . . capacities range from 155 to 4000 tons per hour. Bulletin #126 gives full engineering details. A copy is yours on request.

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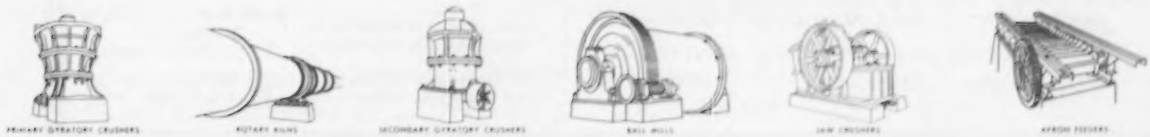
GYRATORY CRUSHERS



Climax, Mallinckrodt Sign to Make Uranium Salts

PROPOSAL FOR CONSTRUCTION and operation of a plant for production of refined uranium salts will be submitted to the AEC by Climax Molybdenum Co. and Mallinckrodt Chemical Works, it was disclosed early in May.

While no site was mentioned in the joint announcement, Grand Junction, Colo. was in the forefront of logical locations since all uranium concentrates from western mills are shipped to the AEC compound there.

Announcement that both companies have signed a joint agreement to submit a proposal for a salts plant came from Arthur H. Bunker, president of Climax, and Charleston MacVeah, vice chairman and treasurer of Mallinckrodt. If the proposal should be accepted, they said, a jointly owned company will be formed to construct and operate the plant.

Atomic Energy Commission's proposal for other private enterprise firms to build a plant to produce three types of high grade uranium salts is said to be having heavy going.

No less than 60 major companies—chemicals, oil, gas and mining— attended initial meeting held by AEC to discuss the proposals.

After that first session, bid date was deferred from spring deadline to Oct, 1, 1956.

A second meeting attracted still fewer industry people and the last session at Oak Ridge, Tenn., was reported to have interested only 18 to 20 representatives.

The reason: cost alone of preparing proposals and engineering to be presented in competition with other companies is placed at more than $100,000 for the 5,000 tons of UHF_4, UHF_6 or U_{205} on which AEC will take delivery.

Meanwhile, many of the firms which thought about "going it alone" are now teaming up. Vitro has joined with an unnamed "major company" for example. They also are asking AEC if perhaps two plants to produce these requirements might now be better than one large one.

Cost on the large one is estimated at more than $50-million by some of those who have kicked the project around.

Early consideration by such companies as Vitro Corporation of America and Uranium Reduction Co. to hook the refinery onto present uranium mills has been discarded as impractical.

These two companies, incidentally, are aiming at a Salt Lake location for the facility.

They argue that eventually AEC will have to establish a uranium metal plant in the west, and the refinery salts would be better produced near such a plant.

Dispersion and presence of engineering staffs here also are given as an argument for such a location.

One big worry: Is this truly a bid letting or is AEC, as in case of its recent zirconium program, going to accept "bid-proposals" and then turn around and negotiate on basis of the proposal?

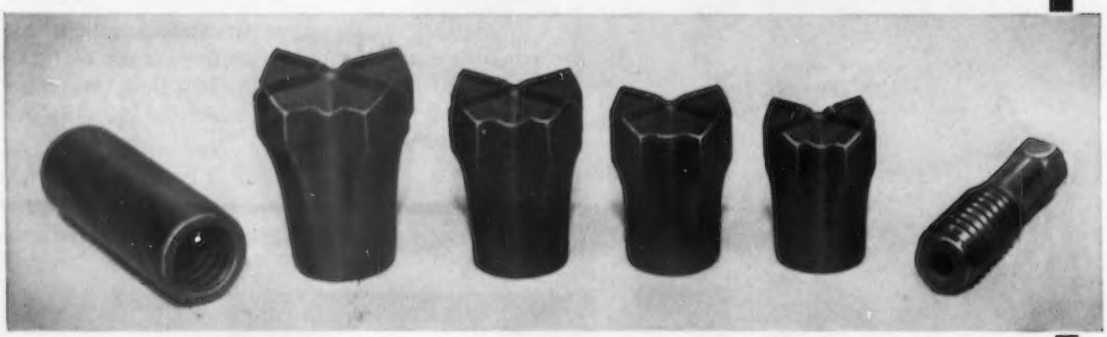
Those considered still "hot" on the idea at presstime include: Catalytic Construction, Union Carbide Nuclear, National Lead, Anaconda Co., Grace Chemical, Atlantic Refining, Stauffer Chemical, Vanadium Corporation of America, the Texas Co., New Jersey Zinc, Olin-Mathieson, URC and Vitro.

Minnesota *(from p 144)*

Cleveland-Cliffs Iron Co. is shipping from six open pit mines on the Mesabi Range: the Canisteo, Holman, Hill-Trumbull, Hawkins, Sargent and Wanless. This group of mines has produced a total of over 102-million tons ore. The Hawkins and Sargent mines were formerly operated by the International Harvester Co.

M. A. Hanna Co. mines were busy during the winter months. The Enterprise began work on an approach to the screening plant March 19. Rock stripping was carried on through the winter. Parcel Three mine stripped surface material with two shovels, excavation was completed for the screening plant, and

BRUNNER & LAY "600" ROK-BITS



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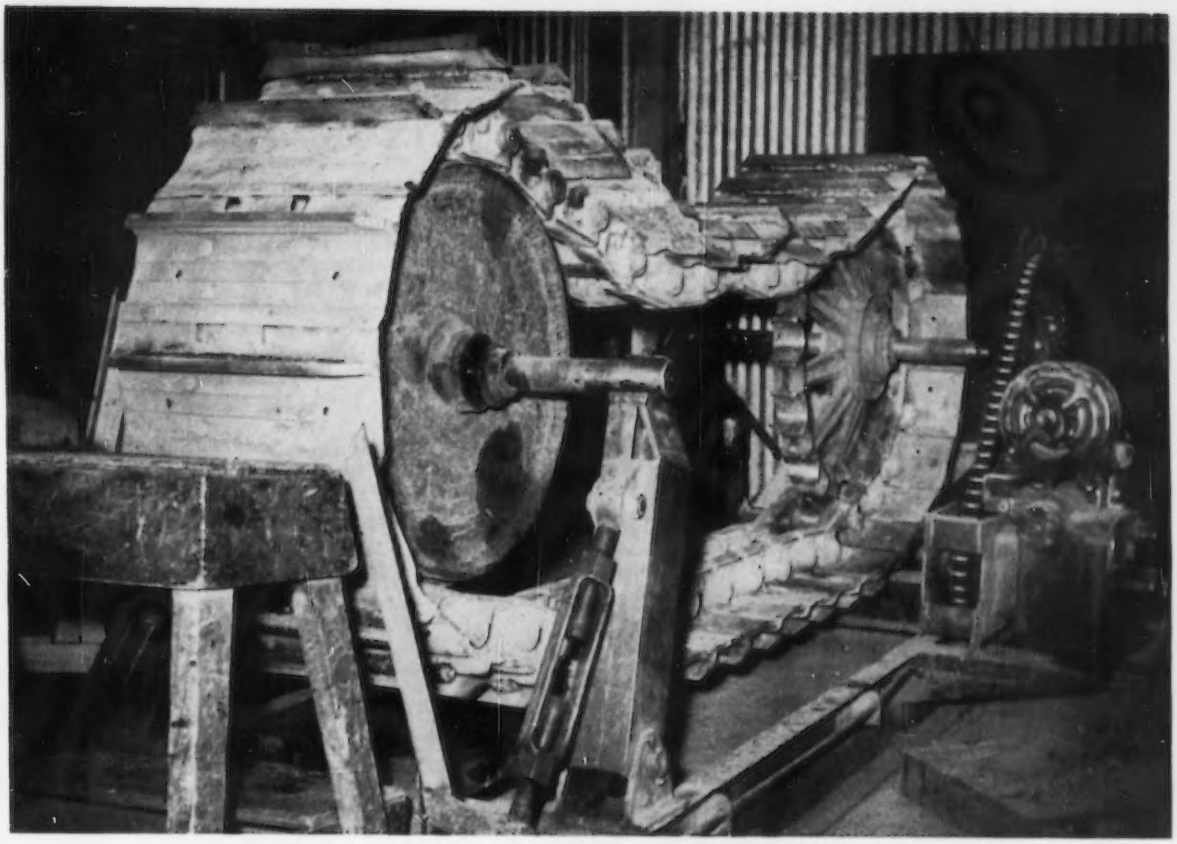

Positioning Fixture for REBUILDING and HARD-FACING TRACTOR GROUSERS

With spreads operating throughout the Western States from New Mexico to Washington, the Isbell Construction Co. with its head office in Reno has complete facilities for maintenance of heavy earth working equipment at its home base. A fixture for positioning crawler track assemblies to speed the repair of grousers is so ingenious as to have attracted wide attention.

In order to keep their tractors moving, the shop has in stock spare tracks for replacement; when grousers are worn, the track is taken off the crawler and sent to the shops, the replacement assembly is supplied and the tractor goes back to work. The old track is mounted on the fixture shown above and, as time permits, the shop weldors handle the rebuilding job. The fixture has a conventional idler and sprocket on which the track is mounted, the device being adjustable to handle a track assembly of varying length. The sprocket is power driven through a gear reducer.

The assembly is rotated so that a weldor can work on grousers at either end, welding in down hand position. The worn grouser is squared up by a cutting torch and steel bar stock, $\frac{1}{2}$" x $1\frac{1}{4}$", is welded on with high tensile electrodes. After the bar is welded in position a single heavy stringer bead of Stoody Self-Hardening is run across the top to give it extra wear protection.

The company has found that this fixture cuts welding time in half, simplifies handling of the track assembly and the use of hard-facing alloys stretches out service life between track overhauls.

The Stoody Guidebook—the "Bible" of heavy equipment maintenance—is yours for the asking. For your nearest Stoody dealer check the "Yellow Pages" of your phone book or write direct.

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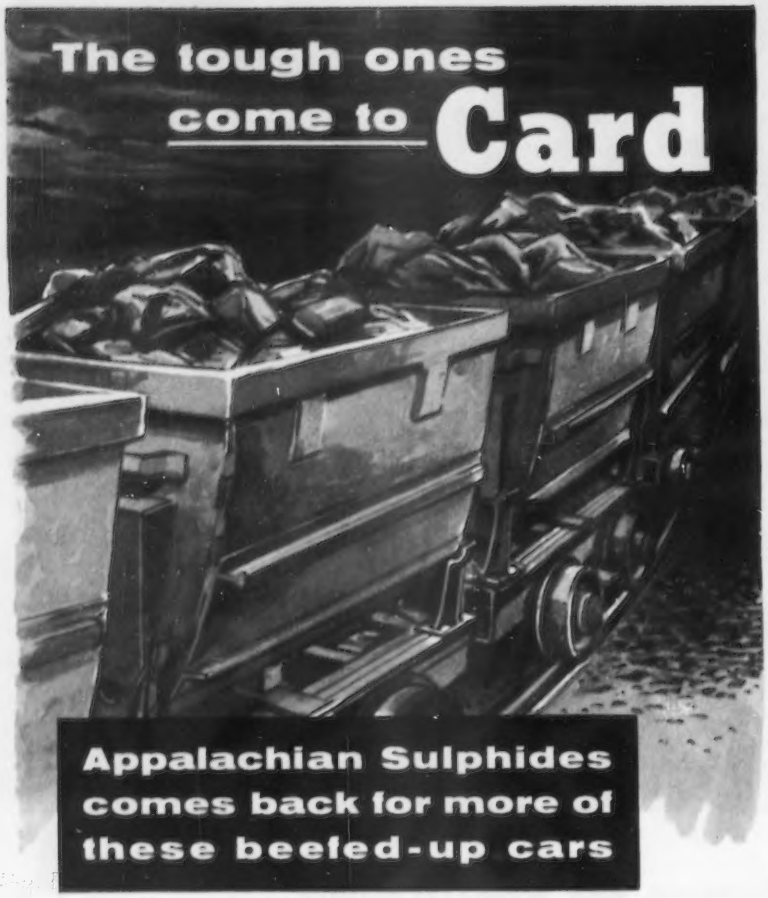
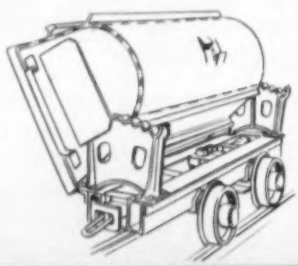


Within a five year period Appalachian Sulphides, Inc., (formerly Vermont Copper Co.) has purchased 42 Card Rocker Dump Cars on four successive orders. The heavy sulfide ore is side-loaded by rocker-shovel, placing unusual strain on the cars. Card engineers worked closely with the customer to produce a 40 cubic foot car which does not break down under this service.

The result is a car body of low-alloy high-strength steel plate, mine rail reinforced, and a frame nearly three times standard strength with proportionately heavy rocker pedestals. It includes the new Card safety locks. Our engineers are always willing to work with you for the right solution to some particular haulage problem. Standardize your haulage with an economical Card design.



C.S. Card Iron Works Co.
2501 WEST 16th AVE.
DENVER, COLORADO

Minnesota *(Continued)*

foundation work begun. Steel erection continued on the plant and additional machinery was installed. The tailings pond has been completed and pipe laid from the plant.

R. T. Elstad, president of Oliver Iron Mining Division, states that the Division's iron ore shipments from the Lake Superior area for 1956 may exceed the 36,245,550 tons shipped in 1955. Division will operate 12 ore treatment plants on the Mesabi Range. Stripping and development work was carried on during the past winter.

A new washing plant which can treat 200 tons of wash ore per hour will be constructed at the Webb mine of the Snyder Mining Co. at Hibbing. Ore will be hauled to the new plant by trucks.

Pickands, Mather & Co. has given a contract to Western-Knapp Engineering Co., Hibbing, for a washing and heavy-media plant to be constructed at the Mahoning mine. Plant will be ready for the 1957 season. Probably over 103-million tons of direct shipping ore will have gone from the Mahoning before the first car of concentrates is loaded.

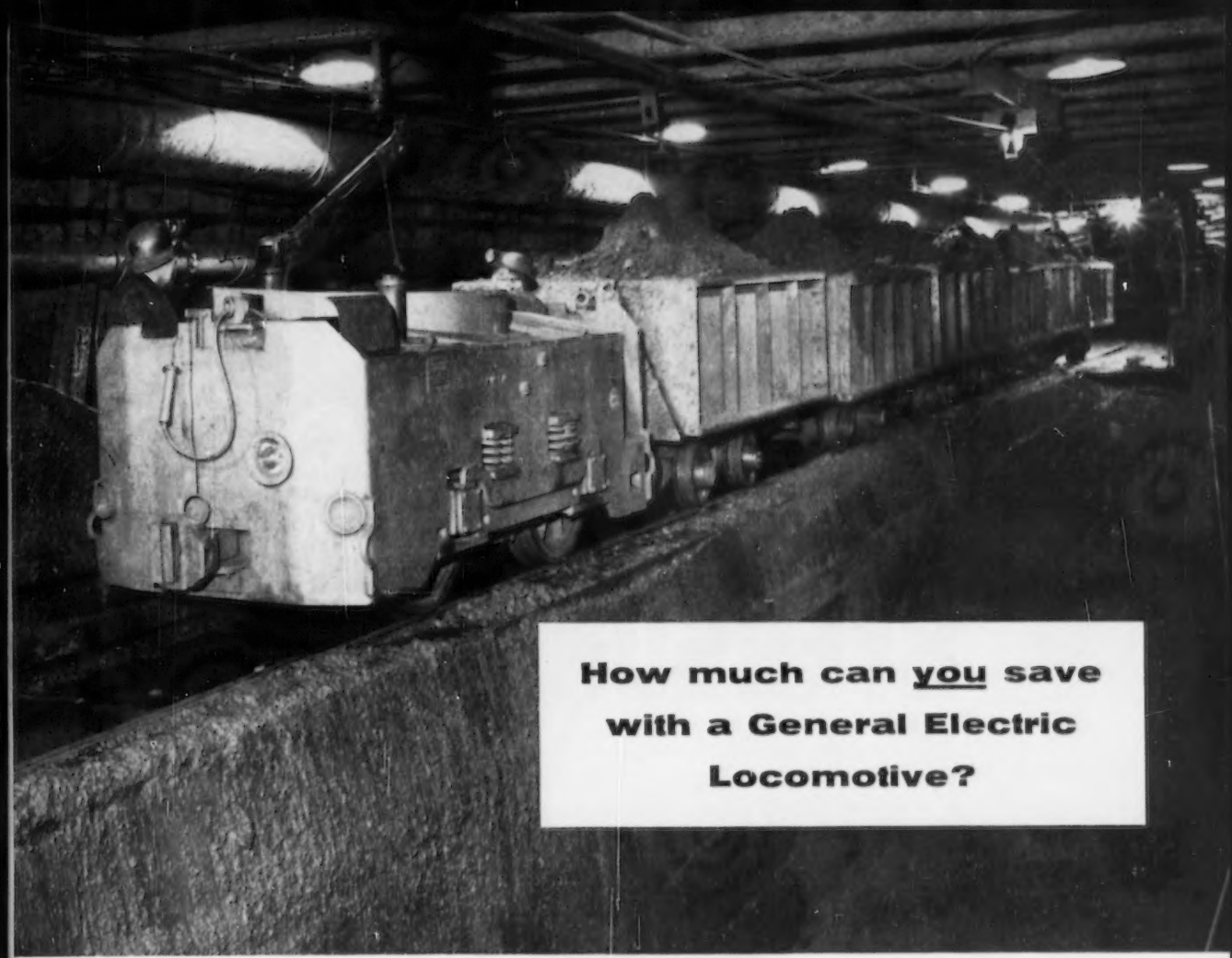
Development costs for a taconite operation—largely costs of the extensive plants which are required for its concentration—are estimated to be from $20 to $30 per ton of annual production capacity. For a plant which could turn out 10-million tons of concentrates per year, this ratio would estimate an investment of from $200- to $300-million—the latter figure probably being a closer approximation.

Republic Steel Corp. is joining with National Lead Co. at a pilot plant operation near Birmingham, Ala., to determine the feasibility of producing iron concentrates from the iron-bearing standstone found in that area. Republic estimates that there are over 1-billion tons of the material in this district alone.

MICHIGAN

On April 9 the M. A. Hanna Co. closed its Richmond mine near Palmer permanently. The Richmond Iron Co. was incorporated in 1898 and operated the old Richmond mine until 1927 when a nearby property was opened and operated as the new Richmond until now.

Development work at M. A. Hanna Co.'s Cannon mine east of Stambaugh has been progressing rapidly. First ore was hoisted March 23, 1955, and 238,075 tons was shipped in that season. During the year from April 1, 1955 to April 1, 1956, 9800 ft of 10x10-ft main level drift; 1200 ft of scraper drift; 6900 ft of sublevel drift and 43,000 ft of raises were completed. Eleven-ton electric locomotives each haul eight or ten 120-cu ft underground mine cars which are dumped into a hopper at the shaft station. From the hopper the ore is fed to a jaw crusher by an apron feeder. Fines are removed ahead of the crusher by a vibrating screen



How much can you save with a General Electric Locomotive?

Cost Saving G-E Locomotives Will Haul a Planned 4000 Gross-tons of Iron Ore a Day for Jones & Laughlin Steel Corp.

Four G-E 6-ton electric mine locomotives are giving Jones & Laughlin Steel Corp. top performance under the toughest conditions at J & L's Tracy Mine in Negaunee, Michigan. These locomotives operate almost continuously 850 to 2500 feet below surface under extremely wet conditions. That's hard on any machine!

The 6-ton cable reel electric mine locomotives offer many advantages. Three of their leading features are:

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3. LOW COST—Power consumption is low because of highly efficient traction motors. Parts needing attention are quickly and easily accessible. And, the smooth ride afforded by equalized spring suspension means less track pounding and rail climbing—less track maintenance.

WHAT ARE YOUR HAULAGE REQUIREMENTS? From the wide range of G-E industrial and mine locomotives—diesel-electric and straight-electric, for both underground and surface haulage, there's one fitted to your needs. For a survey of your haulage requirements, without cost or obligation, contact your local G-E Apparatus Sales Representative. General Electric Co., Locomotive & Car Equipment Dept., Erie, Pa.

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Michigan *(Continued)*

and the sized material is loaded into a storage pocket before going to the skips through measuring pockets which hold one skip load. The mine's pumps are handling about 2,000 gpm water from underground in addition to 800 gpm from a surface well. Standby emergency pumps for 5,000 gpm are held in reserve. Ventilation is provided for by a large propeller type fan which can furnish 100,000 cu ft of heated fresh air per minute. The 13x21-ft shaft was begun in the winter of 1951-'52. It was put down to ledge—143—which was reached in September, 1952, by the Foundation Co. of New York.

Marquette ore docks of the Lake Superior & Ishpeming RR opened the season April 9 when the J. J. Sullivan arrived and began loading ore. The Escanaba docks opened on April 7 with the steamer Hagarty. The harbor at Ashland, Wis. was filled with 24 in. solid ice and was the last port to receive ore boats. The first boat arrived April 23. Canadian National dock at Port Arthur, Ontario, received its first boat April 22.

Cleveland-Cliffs Iron Co. is producing from five underground mines on the Marquette Range: the Mather, Maas, Cliffs, Cambria-Jackson and Athens-Bunker Hill. These mines produced about 5.1-million tons in 1955. Humboldt pit, which produces concentrates from Michigan jasper, is also operating. It made its first shipment in 1954—153,738 tons—with about 20,000 tons more in 1955. The Republic pit, owned jointly by Cleveland-Cliffs, Inland Steel, Jones & Laughlin, International Harvester and Wheeling Steel Corp., is operated by Cliffs. It, too, will concentrate jasper and the plant is rapidly approaching completion for production.

Annual spring safety meeting of the Lake Superior Mines Safety Council was held at Old Caspian April 5. Wesley Johnson, safety engineer for Inland Steel Co., gave a paper entitled "It's Dynamite." J. W. Tysse, Cleveland, manager of safety for Republic Steel Corp., called his talk "Let's See"; and a paper on electrical hazards by Frank M. Bohan, M. A. Hanna Co. electrical supervisor in the Hibbing, Minn. district discussed "Safety Is a State of Mind." The last paper was given by R. W. Edwards, supt. of Inland Steel Co.'s Morris mine at Ishpeming with the subject, "Why Bother With Good Housekeeping?"

MONTANA

New Morning Glory Mining Co. has reported discovery of a hitherto unknown gold-silver-lead orebody at the old Morning Glory property near Troy, Lincoln County. According to A. A. Fagnant, Seattle, secretary-treasurer, the ore was found unexpectedly on the No. 6 level in tunneling toward ore diamond drilled from the No. 4 level winze.

"The ore was found beyond a fault after extending the No. 6 level 150 ft,"

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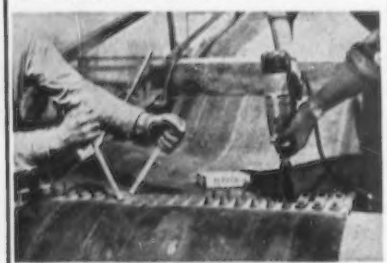
The FLEXCO Power Tool Boring Bit used with electric or air impact tool speeds boring of holes.

New FLEXCO Templet positions bolts for quick joining of belts. Reaching under belt has been eliminated.



Running down nuts is fast with the new FLEXCO Speed Wrench used with electric or air impact tool. Two Bolt Breakers are used together to complete the joint.

If you are interested in speeding up fastener application, order the new Speed Tools from your local FLEXCO Distributor. Write for Bulletin F-112-A.

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4635 Lexington Street • Chicago 44, Illinois

Montana *(Continued)*

Fagnant said. "The first 77 ft of ore varied from 12 to 15 ft in width and averaged $34 a ton. A second fault was crossed and the ore widened to 23 ft averaging about $70 a ton. The main objective is about 150 ft ahead." Directors, at a meeting in Spokane, decided to continue to the main objective on the No. 6 level and then open the ore shoots on the No. 8 level. If ore disclosures warrant it, a 100-ton mill on the property will be enlarged.

Golden Anchor Mining and Milling Co., which is developing a gold-silver-lead property about nine miles south of Elliston, Powell County, has leased six claims near Usk, Pend Oreille County, Wash., it is reported, for uranium exploration. Henry L. Newmiller, of Elliston, is company president.

Moose Hill Mining Co. of Spokane, Wash., has been incorporated to develop, under 25-year lease, the Waylett group of 10 claims, staked on a tungsten deposit in 1953. Company bulldozed a road to the property, near Libby, last September and drilled nine holes to 50 ft. Assays showed scheelite ore averaging about $43 a ton. Bulldozing opened an 8-ft vein.

Capitalization was for $300,000. Officers are: Kenneth B. Morlan, Spokane sporting goods dealer, president; Clair Wynecoop, president of Midnite Mines, Inc., vice president; Jack Blodgett, Spokane, secretary-treasurer, and William Iunkers, Spokane, legal counsel and director.

Firm also plans exploratory work on 800 acres in the Mount Spokane area.

It is reported that underground work at the property of Basin Jib Gold Mines, Inc. at Basin seems to be confirming values obtained from surface drilling. Samples taken across the last 3.5 ft of a crosscut on the 300-ft level showed 0.08 oz gold, 5.2 oz silver, 0.46% lead, 0.76% zinc, and 2.39% copper per ton, although the cut had not yet reached the footwall. Shaft sinking was started last fall, and stopped when a depth of 345 ft was reached. A station was cut on the 300 level and the crosscut was driven 120 ft to the vein zone. When the footwall is reached, a drift will be started in both directions. It is hoped that underground development will outline sufficient ore to support a 300-tpd operation.

NEW JERSEY

Warren Foundry & Pipe Corp. has changed the company name to Shahmoon Industries, Inc., in honor of S. E. Shahmoon, chairman and president. Company is reported considering expansion of annual capacity to 2-million tons a year. Present annual output is about 500,000 tons.

Two new shafts will be required to raise the output, according to Shahmoon. Firm is applying for certificates of necessity.

American Cyanamid Co. has turned over its Gloucester City titanium dioxide pigments plant to New Jersey Zinc Co. Sale agreement was made in March 1954 with action to be taken following completion of Cyanamid's new plant at Savannah, Ga.

NEVADA

Consolidated Eureka Mining Co. has cut a station at the 400-ft depth at its property on Prospect Mountain near Eureka, and has driven a drift 70 ft to the downward projection of the rich orebody discovered a year ago. Shipments of ore are being made on a steady basis to a Utah smelter and show high values in gold, silver and lead. An application for an oil-surfaced road to be built to the property has been filed with the Nevada Highway Department and is expected to be approved soon. The Hogle interests of Salt Lake City control and operate the mine.

Diamond core drilling for uranium on the Atlas group of claims in the Pine Nut foothills east of Gardnerville was begun late in April by Hugo Cavalli, Reno geologist, who said he plans to drill a series of 50-ft holes. His is the first announcement of activity in the Kingsbury Grade area, where much more mining is expected to begin later in the season.

Consolidated Uranium's Linka tungsten

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CHOICE OF TWO GRADES OF TUNGSTEN CARBIDE

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The results of improved manufacturing techniques

OFFSET DESIGN OF WINGS for drag-free rotation, faster removal of cuttings to permit faster drilling, easy and inexpensive reconditioning.

DEEP SLOTTED CHIP-WAYS allow cuttings to escape readily; the bit does not regrind its own cuttings.

IMPROVED TECHNIQUE FOR BRAZING INSERTS to prevent loss of inserts and to assure maximum drill footage and minimum loss of gauge.

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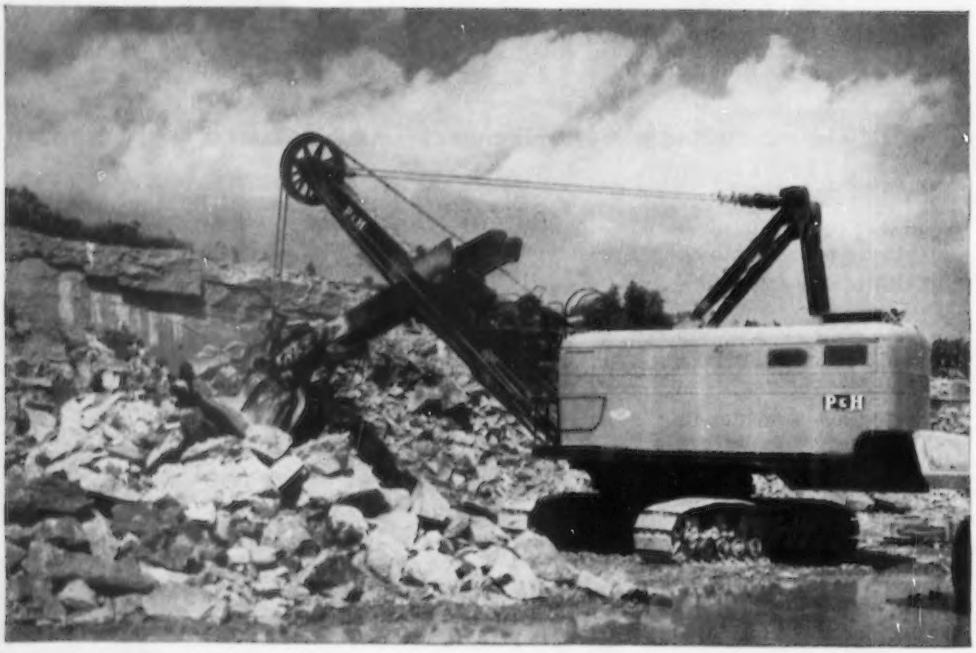
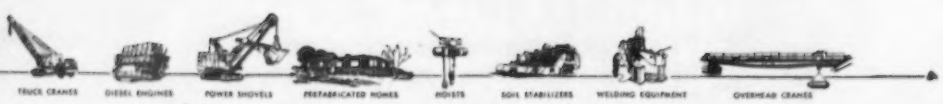


the P&H Line



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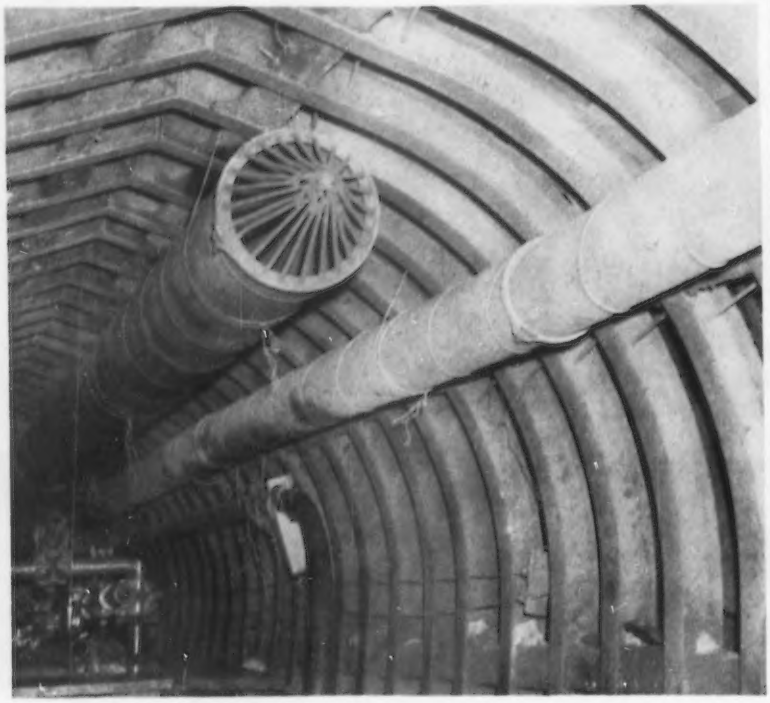

When the curtain goes up on mining operations underground, you're all set when Naylor ventilating lines are part of the scenery.

Naylor pipe provides lightweight lines that can be installed faster and easier. What's more, the exclusive Naylor structure permits the use of lighter gauge material to cut your costs without sacrificing performance.

The Naylor one-piece Wedge-Lock coupling is another dependable "prop" that speeds installation of vital air lines. Lines can be assembled with only one side of the pipe in the open and extended rapidly as the work progresses. It's a combination well worth looking into.

Write for Bulletins No. 507 and No. 514.

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Nevada *(Continued)*

mine and mill near Austin closed April 30 as the result of the end of the Government buying program. The operation employed 120 men, and the 350-ton mill was operated at capacity during the summer and fall of 1955, but when work was halted the crew had been reduced to 14 men. Don Anderson, superintendent, said a crew of five is being held over to do work at the mill, which will reopen early in June for custom work, at which time copper ore will be treated.

Harry Hughes, Goldfield mining engineer, has launched an extensive development program at the Gray Eagle Mine near Battle Mountain. He is being assisted by J. McGlyn, formerly superintendent of the property. Plans call for extension of two tunnels and a diamond drilling program to determine the location of new deposits. Phil Liebel is superintendent at the Gray Eagle. The company's main office is in Bakersfield, Calif.

Leonard Shellenbarger, who has leased the MacBoyle Talc property in Esmeralda County from W. E. and M. C. MacBoyle, is shipping 200 tons of low grade talc weekly to Laws, where it is loaded onto freight cars for rail shipment to Huntley Industrial Minerals Co. in California for use in talcbestos and paint. Mine is an open pit operation. Jim Nicholaus has the contract to do the trucking.

NEW MEXICO

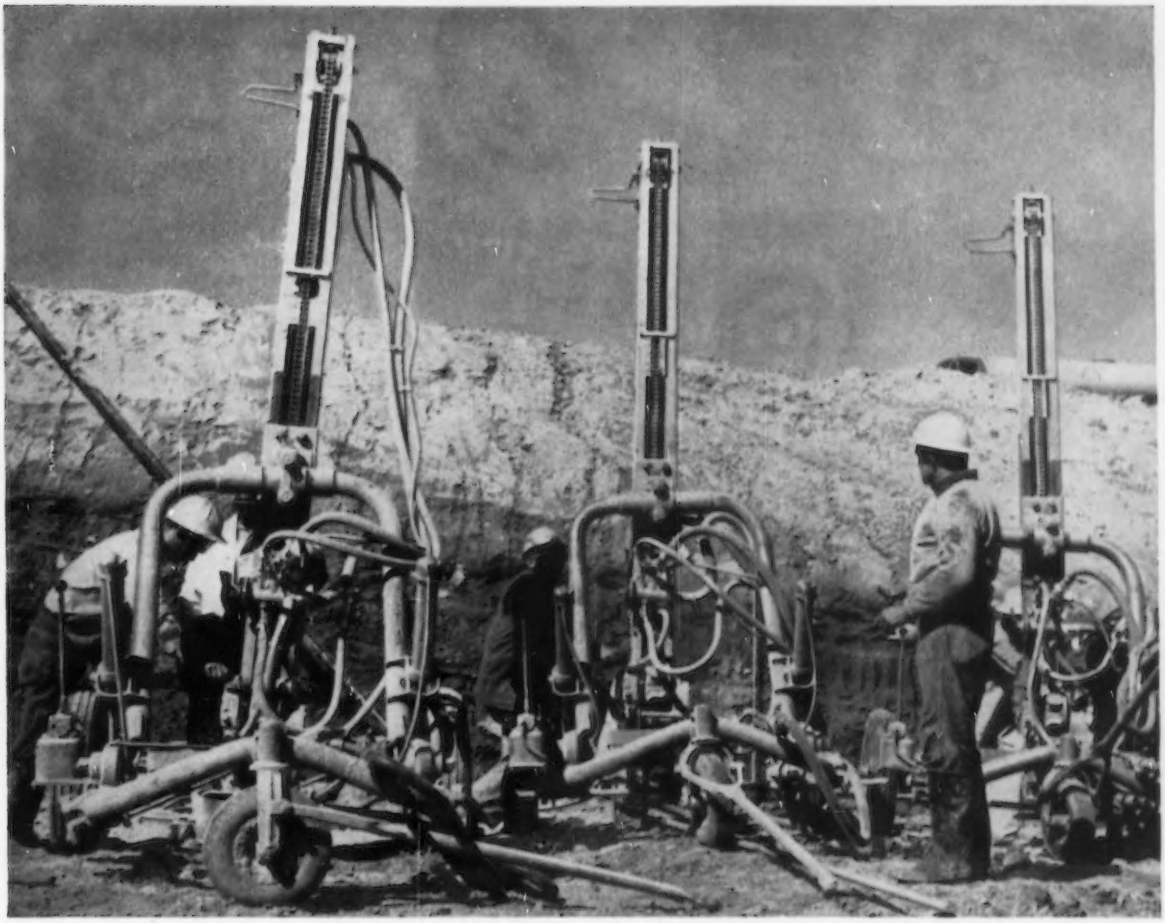
Standard Uranium Corp. has entered into a joint venture with Col-U-Mex Uranium Corp. in the Ambrosia Lake district near Grants. William R. McCormick said under the terms of the agreement Standard will carry out and bear costs for initial drilling and exploration activities on 77 claims covering some 2,000 acres. Agreement states that on commencement of mining operations Standard will receive two-thirds of all mining profits with the balance going to Col-U-Mex. Mining costs will be shared on the same basis. The venture which will operate under the name Stan-Col Uranium, will be under the direction of Standard's management.

McCormick, president of Standard, and Charles A. Steen, president of Utex Exploration Co. announced that their companies have entered into a joint natural gas and oil venture in Eddy County.

Properties purchased in the Standard-Utex venture cover some 2,000 acres and include two producing wells. McCormick said that Sinclair Oil & Gas has agreed to buy the total oil production.

Swank Drilling Co. of Moab, Utah in late April began work on a 25,000-ft contract in the Ambrosia Lake area of McKinley County, N. M., on a two-section lease in which Cataract Uranium, Ranger Uranium and Producers Uranium hold interests.

Ten students from five New Mexico colleges and universities will receive $500 scholarship awards from the Chino Mines



Making blast holes with Bethlehem Hollow during early stages of construction for Long Sault Dam. Contractors are Walsh Construction Co. and B. Perini & Sons; Morrison-Knudsen Co.; Peter Kiewit & Sons; Utah Construction Co.

240,000 cu yd of Dolomite Being Moved for Long Sault Dam on St. Lawrence

What you see here is Bethlehem Hollow Drill Steel making blast holes in dolomite at the site selected for Long Sault Dam, near Massena, N. Y. The dam, part of the St. Lawrence River Power Project, is to be a curved concrete gravity-control structure, 2890-ft long. Including earth wing dams, its eventual length will be 7340 ft. Its 30 ogee spillway openings will be controlled by 50 ft x 28 ft vertical lift gates, flanked by concrete overflow sections and earth embankment to high ground at each end.

Bethlehem Hollow was used almost exclusively on this job, in $\frac{7}{8}$-in. hexagons and $1\frac{1}{4}$-in. rounds, fitted with carbide-insert bits. Because of the rock condition, blast holes were limited to 5 ft. The drill steel performed economically, with minimum breakage.

Wherever there's rock to be moved, whether for a dam or highway, or in a mine, or some other application, you can count on good, steady performance from Bethlehem Hollow. That is because it is rolled from a special grade of steel which is resistant to fatigue. Bethlehem Hollow has a uniform hole, centrally located in the bar. It also has a wide quenching range, and is easy to heat-treat for the proper balance of toughness and wear-resistance, making possible long-wearing threads and strong shanks.

Bethlehem Hollow is made in carbon and ultra-alloy grades, in rounds, hexagons and quarter-octagons, generally in lengths of from 18 ft to 25 ft. It also comes in longer lengths to meet special needs. Keep Bethlehem Hollow in mind for your next rock-removal project.

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New Mexico *(Continued)*

Division of Kennecott Copper Corp. during the school year 1956-57, W. H. Goodrich, Chino general manager, has announced.

OREGON

Tip Top Uranium & Oil, Inc., Denver, has filed 102 applications for uranium prospecting permits on Government land in central Oregon.

Nearly all the property, in Jefferson or Crook County, is "acquired land" on which claim staking is not required. Acquired land has been obtained by the Government through condemnation, gift or purchase, and unlike land in the public domain was not owned by the Government originally.

Bureau of Land Management's Portland office will process the Tip Top applications, which cover about 250,000 acres.

Chemical Lime Co. will begin stockpiling limestone this summer for a lime plant it will build at Baker.

The plant, to be in operation by August, will be constructed 8 miles from limestone deposits where the company has proved reserves that can keep the plant's two kilns in operation for 60 yr.

Annual capacity of the plant is 50,000 tons. Provision will be made for doubling the capacity if needed.

UTAH

Delhi-Taylor Oil Corp. is completing preliminary financing for a $15- to 20-million mining and beneficiation development at its potash property 9 miles north of Moab.

Dr. Elton Soltes, Dallas, Tex., project manager for the potash venture, said that figure includes construction of a beneficiation plant and a mine shaft.

Soltes told shareholders at a recent meeting that he felt a 3,000-ft circular, concrete lined shaft would be started this year.

"Wherever we have drilled we have found potash," he said of the nine deep core holes the firm has sunk at Seven Mile Anticline. Acreages held in potash permits have been increased from 14,000 to 19,000.

A second high grade bed beneath the primary beds has been delineated. But Soltes says while this is to the good, it isn't really needed right now in financing and operating a 1,000 tpd plant for a 25-year period.

Delhi-Taylor is investigating construction of a 23-mile railroad spur to the anticline from the main line at Thompsons of Denver & Rio Grande Railroad Co.

The company has secured water rights on the nearby Colorado River and right of way to the mine area for water lines.

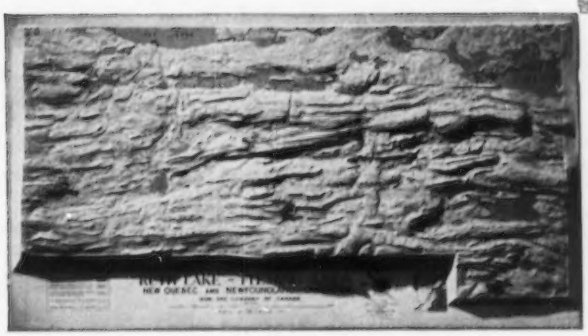
It is engaged in discussing both plant (mill) design with contractors and sinking of shaft with mine contractors.

Over 22 tons of core have been recov-

Important mineral finds are being uncovered by Aero clients with the airborne magnetometer

Precise aerial mosiacs provide valuable reconnaissance and planning data

Accurate Aero topographic maps aid engineering development



Light weight, plastic relief models give Aero maps a 3rd dimension for management

AERO's modern mining tools are cutting exploration and mapping costs . . . helping to locate new deposits of magnetite, ilmenite, nickel and asbestos . . . and putting schedules months and even years ahead. AERO maps are delivered speedily, and are so accurate, mining engineers are using them for plotting boreholes, property lines, rail spurs, access roads, power lines, and other phases of planning and development. Call on 37 years' experience of AERO—pioneer and leader in aerial surveys.

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rubber and neoprene

for

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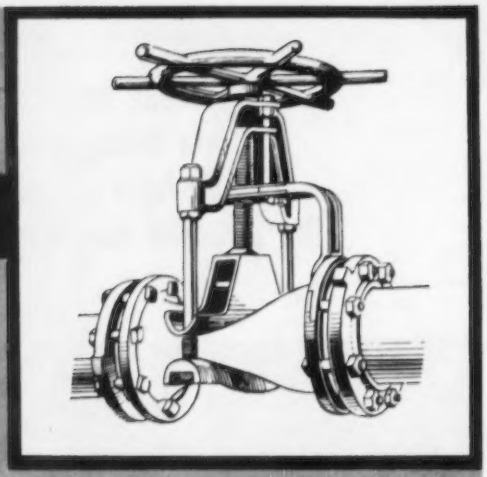
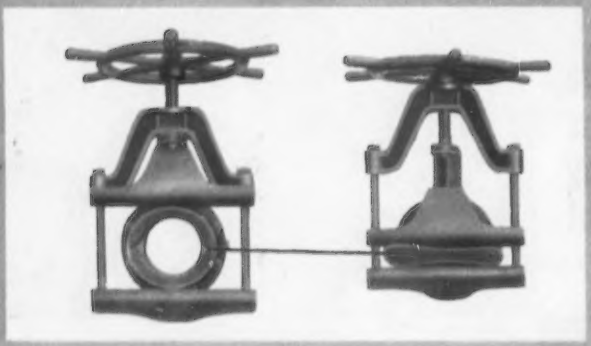


now available with lighter-duty sleeves

The 3, 4, 5, 6 and 8 inch sizes are now available with rubber sleeves for pressures up to 50 lbs. per sq. in., for lighter-duty service. Where applications do not require the standard 150 lb. pressure sleeves, these have the advantage of lower cost and easier operation. They are interchangeable with the 150 lb. sleeves.



...IT'S HINGED... for longer wear

Recesses molded into opposite sides of the sleeve serve as "hinges" during compression. This patented feature prevents undue strain and eliminates breakage and excessive wear due to valve adjustments.

Advantages . . .

- Long life under severe conditions
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- Positive closure on solids
- No working parts in contact with pulps or liquids
- No packing glands
- Minimum friction loss
- Minimum pressure loss
- Cannot leak or stick
- Resistance to oils
- Resistance of the special rubber sleeve to abrasion and corrosion is greater than that of the metallic interior parts of gate valves or plug valves.
- Only ONE wearing part
- Withstands all chemicals not harmful to rubber or neoprene
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- Freezing temperatures are not harmful.

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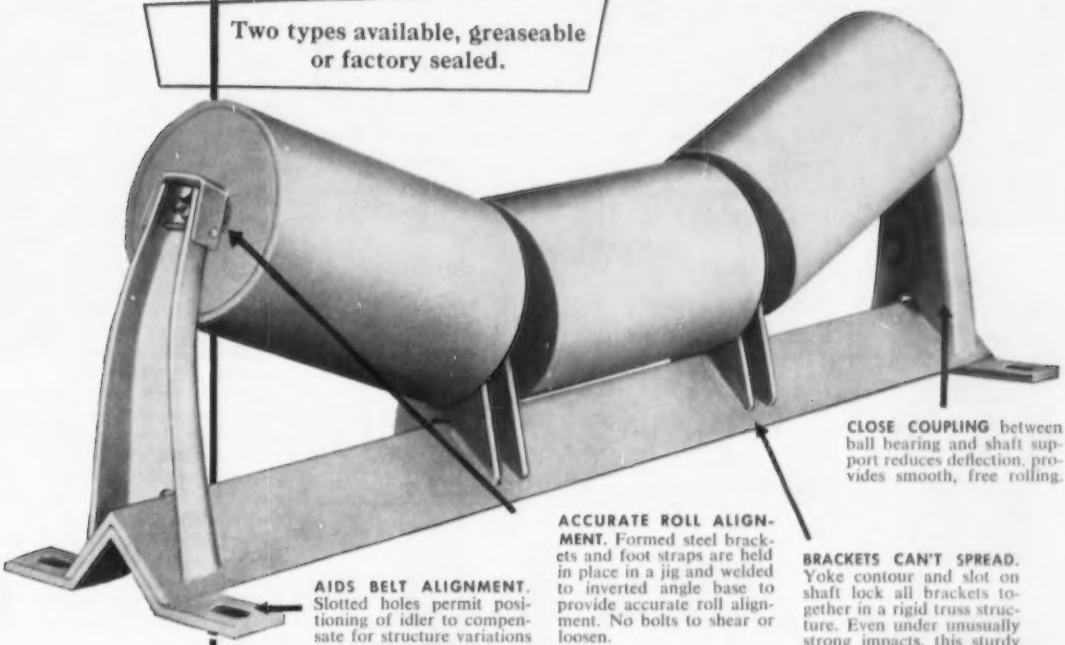
SIZES:

1", 2", 3", 4", 5", 6", 8", 10", 12", 14"

NEW! LINK-BELT Series 50 idler

Two types available, greaseable or factory sealed.



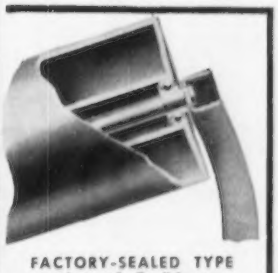
CLOSE COUPLING between ball bearing and shaft support reduces deflection, provides smooth, free rolling.

ACCURATE ROLL ALIGNMENT. Formed steel brackets and foot straps are held in place in a jig and welded to inverted angle base to provide accurate roll alignment. No bolts to shear or loosen.

BRACKETS CAN'T SPREAD. Yoke contour and slot on shaft lock all brackets together in a rigid truss structure. Even under unusually strong impacts, this sturdy arrangement prevents spreading of brackets.

AIDS BELT ALIGNMENT. Slotted holes permit positioning of idler to compensate for structure variations and to allow for training of the belt. Two bolts in each foot strap give greater stability and rigidity.

GREASEABLE TYPE has triple-labyrinth metal seal giving mechanical protection to moving parts while keeping grease in and dirt out.



FACTORY-SEALED TYPE consists of flexible synthetic rubber lip seal bonded to metal backing. No further lubrication is required.

- **Initial and long-lasting economies**
- **Low power requirements**
- **Smooth, free rolling**

HERE's a new idler designed for belt conveyors carrying medium loads or for intermittent operations. It's the new Link-Belt Series 50 which takes its place in industry's most comprehensive belt conveyor idler line.

Backed by Link-Belt's vast engineering and manufacturing knowledge and experience in designing complete belt conveyor systems, the Series 50 is a self-contained, well-balanced unit with bearings fully enclosed and protected. The roll consists of a smooth, uniformly thick outer shell plus a heavy-wall steel center tube brazed to dished steel heads, forming a strong, moisture-proof, integral unit. Ends of the outer shell are counter-bored, and the center tube is journalled concentrically to assure roll alignment.

For data on the Series 50, write for Folder 2516. Your Link-Belt office or authorized stock-carrying distributor will also give you all the facts along with Book 2416 on the complete Link-Belt idler line.

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Problem	Solution
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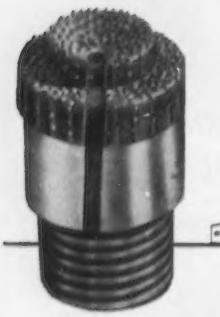

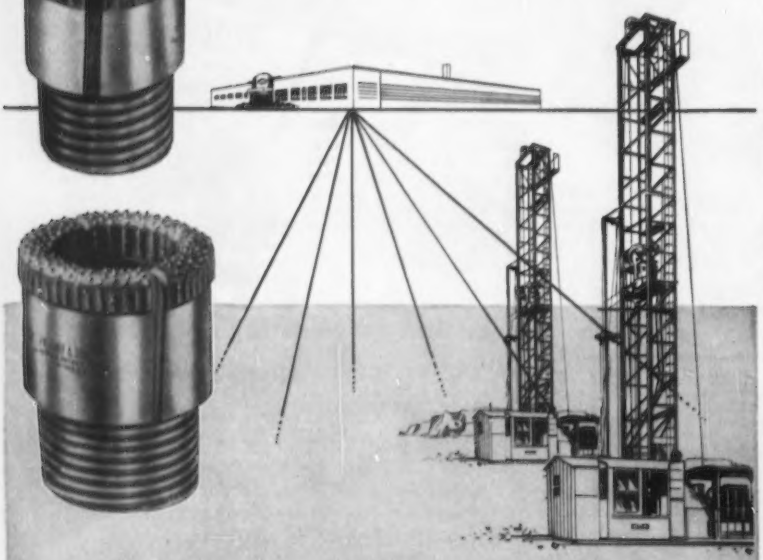

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Utah *(Continued)*

ered in past year, he reports. Many of them are being used in Dallas laboratory in preliminary pilot plant work preceding go ahead on the beneficiation unit.

In addition to huge reserves of sylvite (potassium chloride) Delhi-Taylor has encountered very substantial reserves of carnallite (magnesium chloride and potassium chloride combined). Soltes says uses and application for this is now being explored. He regards these discoveries as a "plus factor."

Marketing studies continue, including freight rate and transportation charges.

Soltes maintains Delhi-Taylor has leased all the available large deposits of potash in the area. A survey of the entire Paradox Basin of southeastern Utah for other large deposits has been undertaken.

Utah Securities Commissioner Milton Love says that about 50% of the 210 small uranium firms registered with his office have encountered ore.

But he believes that of that 50%, 15 to 20% will be very lucky to develop commercially mineable properties on which dividends would be paid shareholders.

Love noted, however, that this is the "nature" of mining and that uranium mining is even more speculative than nonferrous operations as uranium ore generally is found in pockets and not in fissure systems.

The Securities Commissioner underscored the importance of uranium mining to Utah with the statement he had been advised by University of Utah department of Mines and Minerals Industries that estimated production of ore from Utah uranium mines last year totaled 2.7-million tons valued at more than $71-million.

Kern County Land Co. has signed an exploration agreement with Circle Cliffs Uranium Co., Salt Lake City, covering exploration on 100 claims of the latter firm in Garfield County, Utah.

If any commercial, mineable ore is found in the Circle Cliffs district in this probe, net profits would be shared equally between the companies.

Increased exploration and development work at Park City properties during first quarter 1956 resulted in a loss of $33,642 for the period, John M. Wallace, president, reports.

He said that the lead-silver-zinc producer had a net profit before depletion but after taxes of $155,880 for like quarter last year.

Total income for initial quarter of 1956 amounted to $579,800 versus $631,370 in like term last year. Mr. Wallace said:

"The large percentage of production is being mined from the Ontario unit of the property. In addition to normal development work in the upper and lower levels of the Ontario mine extensive exploration is being carried out in the following areas:

The Thaynes shaft, the Zev shaft, the Silver King main shaft. The joint area between the Silver King and the Daly West-Judge mine along the Crescent and

Stainless Steel pays its way *7 times over* in beneficiation of rare earths

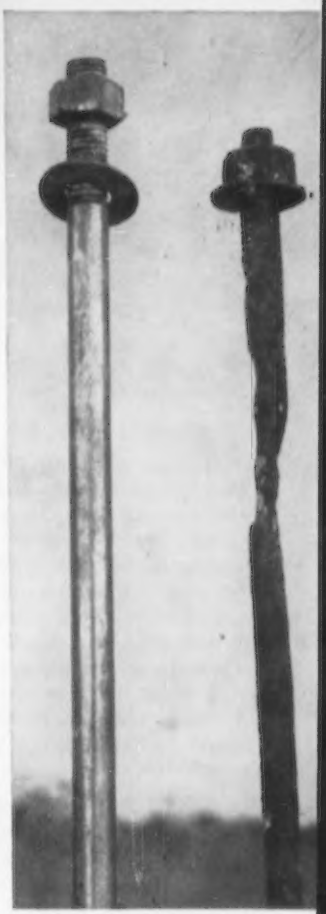
Rare Earths, Inc., of Pompton Plains, N. J., is a major producer of thorium and rare earths, such as cerium, lanthanum, praseodymium and samarium. In the usual form of oxides or salts, these metals have great value in the manufacture of high luminosity carbon electrodes, non-corroding optical glasses and polishing abrasives—to name just a few of the many uses.

Typical plate assembly. Stainless is used for rods and screws in plate hanger.

Most monazite ores (the type processed at Rare Earths, Inc.) are purified by an elaborate chemical separation method. A precipitate is formed and then filtered in a 24-foot-long, 42-inch-square filter press. The wooden plates are held together with long steel rods, which formerly had to be replaced every 6 months because of intense corrosion.

The type 316 Stainless Steel rods, which they began to install as replacements in 1949, are still in perfect condition and have paid for themselves 7 times over. There is much less down time on the filter press and production is up. Although the applications are classified, Stainless Steel is used in many other places at the plant. In the words of Richard Mandle, Plant Manager, "We heartily recommend the use of Stainless Steel for acid and corrosive conditions."

When you buy Stainless Steel equipment, be sure of service-tested quality. Specify USS Stainless Steel.



The new and the old. Carbon steel rod at right had less than 6 months service.

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Sprague & Henwood manufactures other sizes and types of diamond drilling machines and will have the machine you need. They also manufacture a complete line of core drill accessory equipment including diamond bits and reaming shells. Write today, giving full particulars of your needs. Detailed information and recommendations will be forwarded to you immediately, without cost.

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Sprague & Henwood is the leading contract drilling firm in the United States, and crews are available for work throughout the country. Inquiries for all types of contract drilling work will receive prompt attention, and estimates submitted promptly.

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Utah (*Continued*)

Daly-Judge fissure and in the Park Utah mine.

A heavy duty diamond drill is being used to explore formations below the main tunnel level and two light-weight drills are used for short range work. Exploratory percussion drilling is being driven at rate of about 4,000 ft monthly.

Mill returns for the first week of April showed 172 tons of ore assaying 0.447% uranium oxide were delivered from the Allen No. 2 mine in Red Canyon by Utaco Uranium, Inc. Utaco holds the operating lease on the Allen No. 2 from Lakeside Monarch Mining Co.

Uranium Reduction Co. announced in April it will add an alkaline leach system, probably employing resin-in-pulp process, to its new plant under construction at Moab.

Blue Lizard Mines, Inc., announced it is stepping up production from its famed Blue Lizard mine in White Canyon to 1,000 tons monthly. Board chairman Briant G. Badger said the mine produced $31,000 worth of ore in one recent 17-day period.

WASHINGTON

Hecla Mining Co., announcing a more aggressive exploration program, told stockholders at a Spokane meeting April 27 that it has signed an operating agreement with Greenbluff Uranium Co., Inc., to explore two 80-acre leases south of the Daybreak Uranium Mine in northern Spokane County. Robert E. Sorenson, chief geologist and vice president, reported that some autunite located in an open trench and in springs emits high radioactivity from radon gas.

Hecla crews began geological mapping, geophysical tests, bulldozing and drilling almost immediately after the contract with Greenbluff was disclosed. Hecla will acquire a half interest in the Greenbluff leases after it locates a commercial body of ore, or spends $25,000 in development.

Hecla already had entered the uranium field in Utah on the Hot Rock claims. L. J. Randall, president, said Hecla expected to produce 4,000 tons of ore assaying 0.32% uranium oxide from the Radon Mine by the end of April. Only two of 25 holes drilled on the adjoining Hot Rock claims indicate ore.

Dawn Uranium and Oil Co. announced discovery of a new autunite orebody south of its open-pit operation in the Mount Spokane district. The new find also lies on the Smith lease of the Target Uranium Co. which Dawn operates under a joint agreement. Extent or value of the new body was not determined. More than 1,000 tons of stockpiled ore is being assayed for shipment to Vitro Uranium Co. for processing.

Sunshine Mining Co. told stockholders May 2 that it has struck oil in the Ostermiller area east of Denver, Colo., and the strike may open a new field.

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model D

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more PRODUCTION-BOOSTING FEATURES

Choice of Allis-Chalmers engines

GASOLINE — 50 brake hp. Bare grader weight —8,800 lb. Four forward speeds to 25.6 mph, one reverse to 3.3 mph.

DIESEL — 50 brake hp. Bare grader weight — 9,350 lb. Four forward speeds to 25.2 mph, one reverse to 3.2 mph.

ROLL-AWAY moldboard rolls the load instead of pushing it, moves more dirt, uses less power.

Plus one-piece tubular frame, tandem drive, real operator comfort, hydraulic blade lift.

USEFUL OPTIONAL FEATURES

Power circle turn for faster, easier, better control of blade . . . turns 135 degrees.

Leaning front wheels with heavy-duty axle, for better control in close quarter-work.

Hydraulically shiftable moldboard to speed work around obstructions. Shifts 16 in. each way.

Special large tires for added traction, long wear. Front (7.50-20 or 8.25-20) and rear (8.25-20).

more JOB-MULTIPLYING ATTACHMENTS

Hydraulic scarifier, mounted amidships for maximum effective ground pressure.

Shoulder maintainer for safe, one-pass operation. Also available: one-pass windrow eliminator.

Rear-mounted 5/8-yd loader for fast, low-cost handling of materials.

plus snowplows, completely enclosed standup cab, hydraulically operated mower.

more SATISFIED USERS

Since its introduction in 1949, thousands of satisfied owners have *proved* the usefulness and low-cost versatility of the Model D on all kinds of construction and maintenance.

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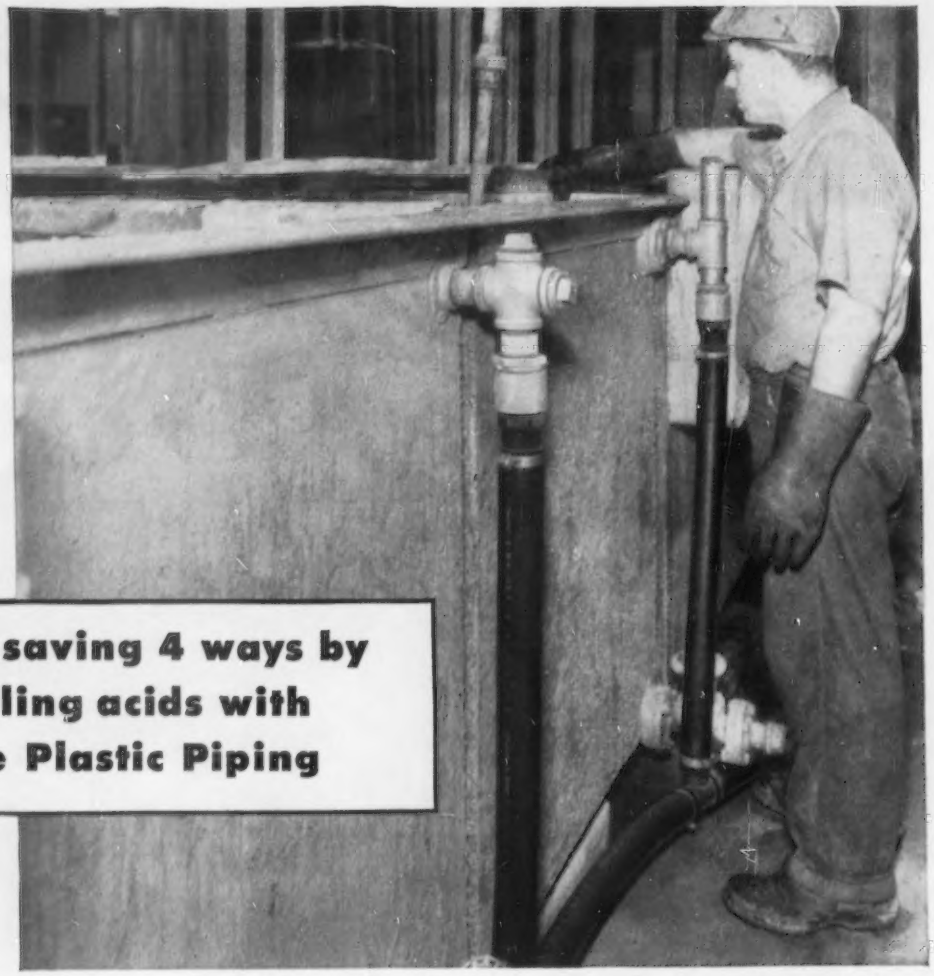


They're saving 4 ways by handling acids with Crane Plastic Piping

THE CASE HISTORY— Globe-Union Inc., leading storage battery builder, in its Milwaukee plant, might have decided plastic piping wasn't for them and let it go at that. Instead, they gave Crane plastic products a fair trial, and here are the results.

On hydrochloric acid lines to zinc-plating tanks, the metal pipe and fittings formerly used had to be replaced completely about every month. Corrosion was the cause.

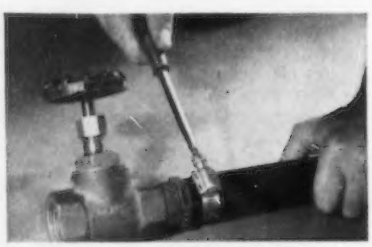
With Crane polyethylene pipe and Crane plastic fittings in this same service, after more than 3 months there is no sign of deterioration and no apparent need of early replacement.

On battery test tanks, Crane plastic piping, exposed to built-up sulphuric acid concentration, looks good as new after more than 4 months' service.

Savings with Crane plastic piping are adding up 4 ways. Plastic cancels the need for costlier metal pipe. It is installed in a fraction of the time it takes for metal pipe and fittings. It reduces installation to a one-man job with simple hand tools. The longer life of plastic is saving replacement, maintenance and housekeeping costs.

Proved in severest services, Crane plastic piping is giving Globe-Union equal satisfaction on many low-pressure air and water lines. Here freedom from sweating is another advantage of plastic.

Once you know the facts of quality-designed, quality-made Crane polyethylene pipe and Crane plastic insert fittings, you, too, will see many opportunities for saving with this modern piping. Call your local Crane Representative today, or write to address below.



Crane adapter makes plastic-to-metal joints easy

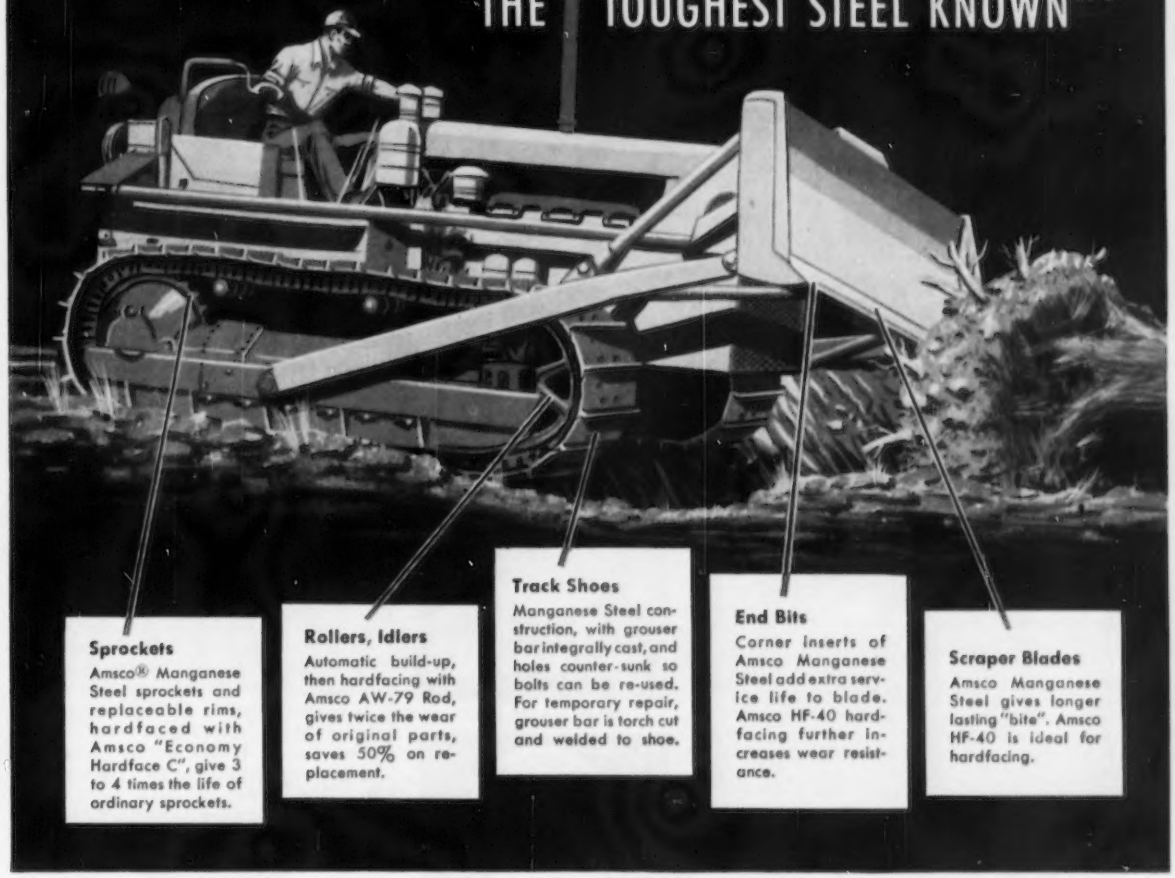
CRANE PLASTIC PIPING

VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

At these TOUGH WEAR points, specify

"THE TOUGHEST STEEL KNOWN"*



Sprockets
Amsco® Manganese Steel sprockets and replaceable rims, hardfaced with Amsco "Economy Hardface C", give 3 to 4 times the life of ordinary sprockets.

Rollers, Idlers
Automatic build-up, then hardfacing with Amsco AW-79 Rod, gives twice the wear of original parts, saves 50% on replacement.

Track Shoes
Manganese Steel construction, with grouser bar integrally cast, and holes counter-sunk so bolts can be re-used. For temporary repair, grouser bar is torch cut and welded to shoe.

End Bits
Corner inserts of Amsco Manganese Steel add extra service life to blade. Amsco HF-40 hardfacing further increases wear resistance.

Scraper Blades
Amsco Manganese Steel gives longer lasting "bite". Amsco HF-40 is ideal for hardfacing.

*AMSCO MANGANESE STEEL . . . plus AMSCO HARDFACING

Shown above are just a few of the "tough wear" points where Amsco products can save you money. Whether for original parts, or for build-up and hardfacing, specify Amsco Manganese Steel and Amsco Hardfacing for maximum operating economy.

We'll be glad to give you full information on Amsco Tractor Parts, Hardfacing Materials or Automatic Welding Machines. Just call your nearby Amsco representative, or write us direct.

OTHER AMSCO PRODUCTS

DIGGING: backhoe buckets—dippers and parts—repointers—dragline bucket parts—dragline chain—sheaves—pinions.

CRUSHING: concaves—mantles—jaw plates—mill liners—hammers.

HANDLING: truck bed liners—grizzly parts—car wheels and liners—sheaves, gears, pinions.

WELDING: automatic and semi-automatic welders—hardfacing rod—manganese plates and shapes.

AMERICAN Brake Shoe COMPANY

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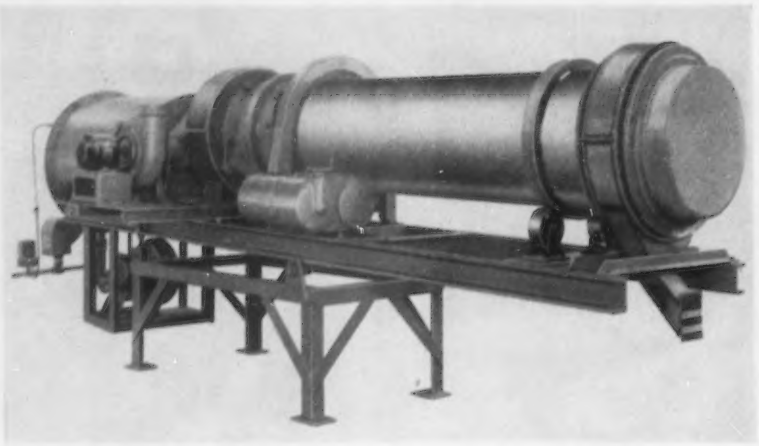
American Manganese Steel Division • Chicago Heights, Ill.

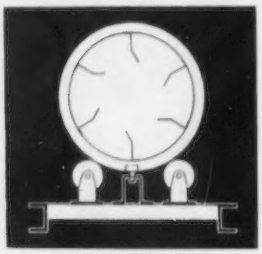
OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DEL., OAKLAND, CAL., ST. LOUIS, JOLIETTE, QUEBEC



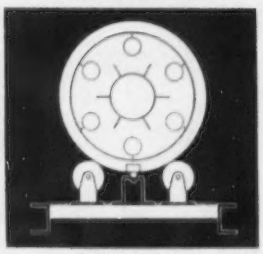
PILOT PLANT ROTARY DRYER

The Ruggles-Coles Pilot Plant Dryer is designed especially for laboratory use or for small capacity unit operations requiring a continuous or intermittent drying step. Each unit:

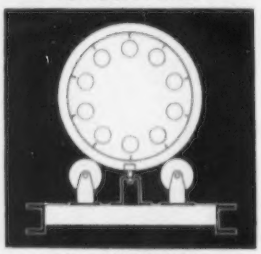
- Is mounted on a structural steel base.
- Has removable "knockers."
- Provides for easy changing of shell rotation speed or shell slope.
- Is available in stainless steel or other corrosion-resistant materials.
- Requires only fuel supply and power connections to be placed in operation.
- Is easily moved from place to place.



XH-XF SINGLE-SHELL



XB DOUBLE-SHELL



XC STEAM TUBE

It is available in three models:

(1) XH-XF single-shell, direct gas fired dryer. Arranged for either parallel or counter-flow operation. Bulletin AH-471.

(2) XB double-shell, indirect-heat, gas-fired dryer for drying without contamination. Volatiles removed with only limited dilution. Bulletin AH-472.

(3) XC steam-tube indirect heat dryer. Can be connected to any available steam supply or furnished with a 3-HP steam generator. Bulletin AH-473.

For complete information write Department 1.

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Washington *(Continued)*

R. D. Leisk, vice president, said Sunshine's Colorado exploration is a joint venture with the Denver Basin Oil Co. under the name Denver Basin Petroleums.

In the first test of a mining law passed by Congress last year, U. S. Forest Service has notified holders of mining claims on the north fork of the Snoqualmie River east of Seattle that they have 150 days in which to make a showing of what surface rights they will need for their mining operations, if any.

The notice affects all unpatented claims filed on or before July 23, when the new law became effective.

Hundreds of mining claims have been filed in the North Fork area of the Snoqualmie National Forest, although virtually no mineral production is reported. Forest Service officials contend that many of these claims were filed by persons primarily interested in getting sites for summer homes or in cutting timber on the land.

The 1955 law gives the Bureau of Land Management the right to determine what use, other than mining, may be made of surface rights of mining claims. Ten years probably will be required to complete the determination of claimants' rights in all Pacific Northwest forest, said J. Herbert Stone, regional forester.

Daybreak Uranium, Inc., announced agreement on a new one-year contract for shipping up to 2500 tons per month to Vitro Uranium Co., Salt Lake. Effective May 1, 1956, the contract supercedes one for shipments from 400 to 900 tons monthly.

Company planned to begin shipments during May, depending on road conditions. Kae H. Sowers, secretary-treasurer of Daybreak, noted that the contract may be cancelled with 30 days' notice, permitting the company to divert its ore to a Spokane mill if one is built.

Six of the seven holes drilled on the reservation "show significant mineralization," according to H. W. Norman, company geologist. More work is required to learn the amount and grade of ore. Diamond drill holes, about 100 ft apart, were put down along 750 ft of the Lowley lease, cutting a series of mineralized zones at depths from 10 ft to 185 ft.

Stockpiling ore has begun. Bulldozer trenching is under way on the adjoining Bair lease, where a highly radioactive vein has widened from 1- to 12-in. at a depth of 3 ft. Diamond drilling will be required to determine the extent of the ore.

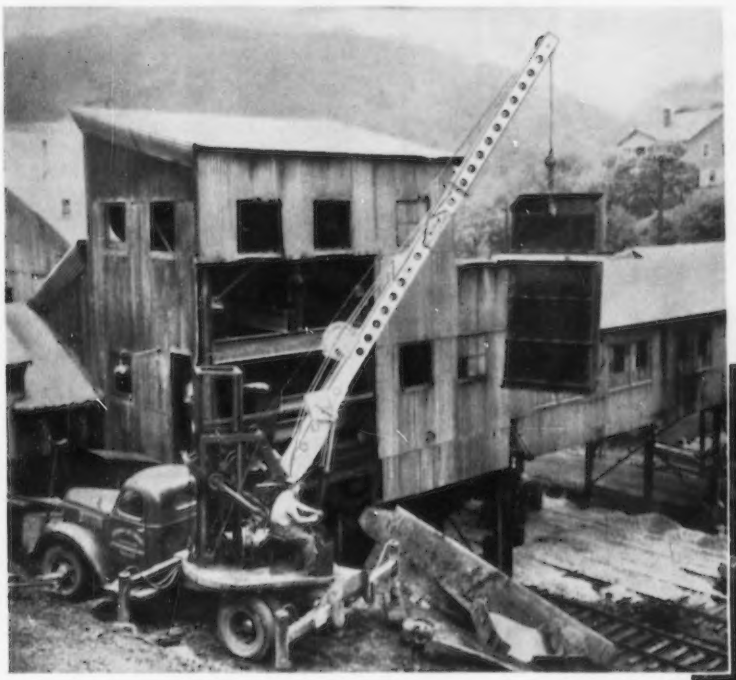
Sunshine Mining Co. has moved its general offices from Kellogg, Idaho, to Spokane, according to Robert M. Hardy, Jr., executive vice president. Ross D. Leisk, vice president and general manager, has moved to Spokane after 20 years at the Idaho property. Other personnel will be moved within a few months.

Hardy said the change was made because the company has expanded operations.

Kromona Mines Corp., with properties in Snohomish County, has advised stock-

Extra Reach with Precision Touch

NEW ½-Yd., 9-Ton H-5 HYDROCRANE



Muck comes up, shaft goes down — fast with a Hydromucker. Eliminate tough, expensive hand-mucking with this hydraulic bucket. Controlled from upper shaft, it loads blasted rubble from the shaft floor to skip or other conveyor for removal to the surface. Owners report up to 35 per cent faster mucking, 30 per cent less man power by using the new Hydromucker.

The Bucyrus-Erie H-5 Hydrocrane combines 50 feet of maximum boom reach, plus a 20-ft. jib extension, with all the work advantages of smooth, precise hydraulic power and control, all the travel advantages of a conventional motor truck. In addition, the boom extends and retracts hydraulically within a 12-ft. range — while the crane-excavator is working. With this machine you can handle mine timbers, erect and dismantle conveyor machinery, clean up ore spillage, dig trenches, clean out drainage ditches— maneuver in close quarters with a smoothness and safety never before possible with a crane-excavator in the 50-ft. boom range.

New Flexibility, New Roadability

Patented outriggers permit you to mount the crane on a new or used commercial truck of your choice. You can select a heavy tandem truck for heavy-duty work or a lighter truck for fast between-mine travel, and still meet highway laws for over-all length and axle loads. Both the high-lift 50-ft. boom and the standard 36-ft. boom retract to 25 feet for travel. Maximum over-all length, depending on truck, is under 35 feet.

Get all the facts now on the new H-5 and the improved ⅜-yd. H-3 Hydrocrane from your Bucyrus-Erie distributor. 136M56

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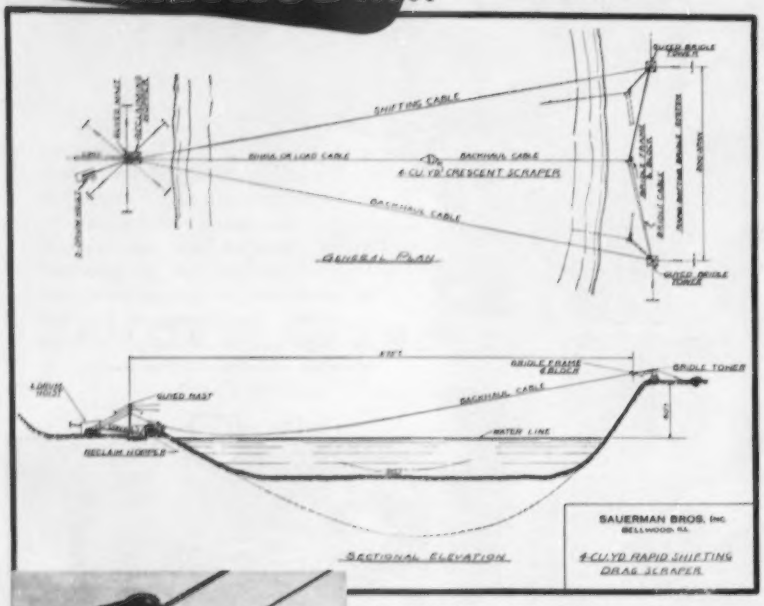
South Milwaukee, Wis.

the SAUERMAN METHOD.....

Scraper Machines Engineered to Your Operation



Above drawing was prepared for a specific drag scraper installation and does not represent maximum spans.

View shows rapid shifting bridle frame and all operating cables. Crescent may be seen in background conveying load to reclaiming hopper just in front of mast.

•

Contact Sauerman's engineering department for specific recommendations and information. No obligation.

Ask for Catalog A, Drag Scrapers—24 pages of job photos and specifications. Request Field Reports showing your material being handled by the low cost Sauerman Method.

The Sauerman Method works equally well over widely differing areas and span limits . . . on hills, swampy ground or underwater . . . handles any material a dragline can dig.

Every scraper machine is powered by a Sauerman Roller Bearing Hoist, especially designed to withstand sudden shocks and changes in speed.

When a rapid shifter is used, a third hoist drum is added to shift the bridle frame. The rapid-shifting bridle system (upper right of drawing) permits frequent shifting of the scraper's line of operation in non-caving material, shallow excavations or overburden.

Operating costs are lower—basically, it is cheaper to drag material than it is to lift and transport it. You eliminate the power costs of moving heavy machinery about the area. You pay only for pay loads—not dead weight. When expendable parts—sheaves, clutch or brake linings—are replaced, the machine is restored to practically new condition.

Sauerman can help you select the method of materials handling most profitable for your job—a system that will give you the lowest cost per cu. yd. handled.

SAUERMAN BROS. INC.

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Crescent Scrapers • Slackline and Tautline Cableways • Durolite Blocks

Washington *(Continued)*

holders that 1955 smelter returns from milling development ore amounted to $14,968. One hundred tons of concentrates averaged 28.83% copper, 3.93 oz silver and 0.70 oz gold per ton.

The firm spent $110,000 in 1955 developing properties and repairing snow damaged buildings and machinery. Kromona's annual report lists 50,000 tons of developed ore, current assets of $10,550 and current liabilities of $80,912.

Dahl Uranium, Inc., has entered a contract with Frank Wilson of Spokane for stockpiling ore on 20 acres of the original 140-acre Dahl lease in the Mount Spokane district. Contract requires Wilson and the Dahls to split equally profits from ore. Percussion drilling has been resumed and a mineralized zone 35 ft long, exposed by bulldozing and trenching, will be investigated.

The Dahl company also has resumed drilling on section 13 of the Spokane Indian Reservation, adjoining the Midnite Mine. Two test holes 100 ft deep on the Lanham ranch 2 miles east of Wellpinit, on the reservation, produced negative results.

Open pit mining at the Van Stone zinc-lead property near Northport, has been moved from the big north orebody to the smaller south orebody. Ore has been taken from the north pit since operations started in 1952. Production continues at the capacity rate of about 30,000 tons of ore monthly, according to J. C. Kieffer, manager of American Smelting & Refining Co.'s northwest mining department.

WYOMING

R. L. Moran of Riverton has been elected president of the newly-formed Wyoming Mining Assn. Constitution and by-laws were adopted at the first annual convention April 20-21 in Riverton.

Elected vice president was Glenn E. Sorensen of Kemmerer and secretary-treasurer Richard K. Lisco of Casper.

Elected for one-year terms on the board of directors were Lisco, Roy Coulson, superintendent of Vitro Minerals Corp., and Myron Sisson, manager of the Colorado Fuel & Iron Co. at Sunrise.

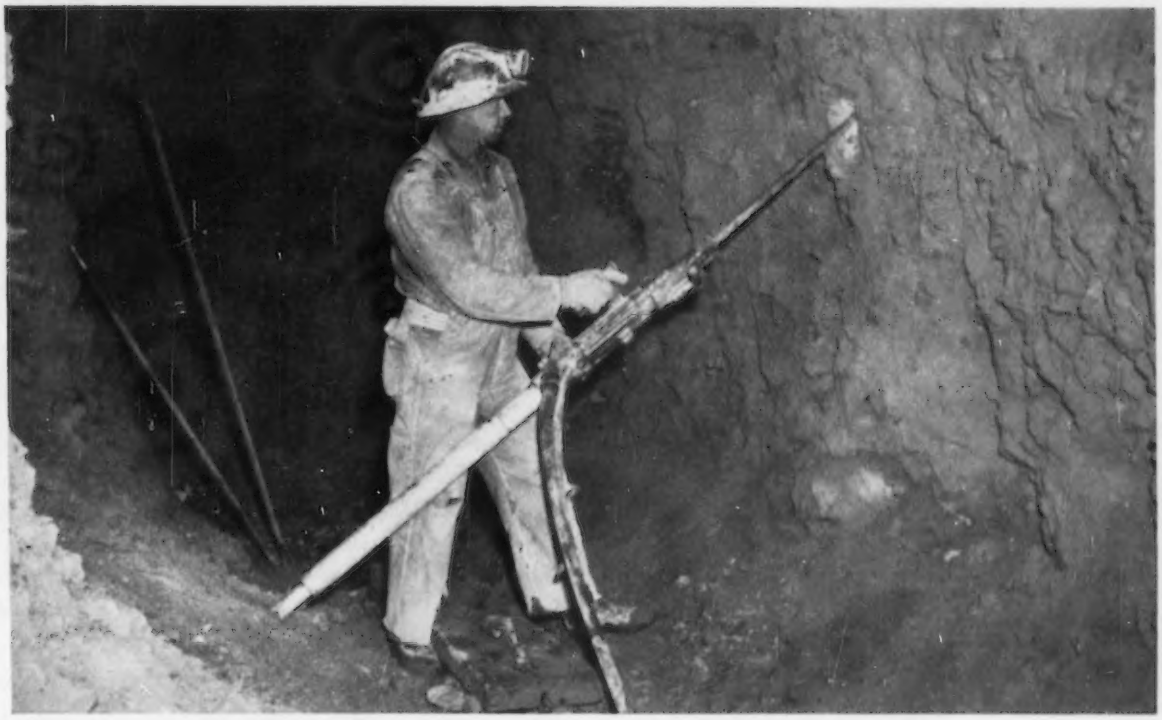
Two-year term members are Sorensen, Moran, Paul R. Peterson, Magnet Cove Barium Corp., Greybull, and C. E. McDougal, assistant resident manager of the Intermountain Chemical Co., Green River.

Headquarters was established in Riverton. Annual meeting of the association will be held the third Thursday in April.

J. Reuel Armstrong, U. S. Interior Department solicitor, Washington, D. C., told the group the "uranium market will not expire in 1962, although there may be changes in the laws governing it."

He said "there will be a market for fissionable material for a long, long time."

Armstrong said he saw no reason why uranium miners in the uraniferous lignites of Wyoming and North and South Dakota should not be eligible for DMEA loans



New Stoper Drill Design Combines 30% Reduction in Weight with 10% Faster Drilling Speed

Use of modern materials in new Le Roi-Cleveland S-10 Stoper results in easier handling.

With the introduction of the new Le Roi-Cleveland S-10 Stoper, great strides have been made in easing the work-load of miners. At the same time, their productivity, in terms of footage drilled per shift, has been increased.

New stoper uses aluminum feed leg to help decrease weight as much as 30% and provide better balance. This type of feed leg, already so successful on Le Roi-Cleveland Air Legs, contributes greatly to weight reduction: The S-10 with 18-inch steel change weighs only 79 lbs!

10% faster drilling speed results from a combination of design features: The new valve is timed and ports are arranged so that a maximum flow of air is delivered to the piston on both downstroke and upstroke. Hard-hitting, rock-shattering blows result, along with a rotation that's strong enough to turn the steel in the worst kind of drilling.

The variable feed-pressure control also adds greatly to the performance of the S-10. It has a wide enough range to feed the machine properly against all kinds of rock. Maximum drilling speed is attained. At the same time, both bit life and machine life are increased.

Exclusive steel puller permits the use of collared steel. This is of special advantage in tight ground, where stuck steels used to be a problem. The new steel puller, consisting of only 5 parts, also makes stoper operation safer. Since the steel never leaves the machine, the danger of falling drill steel is eliminated. The new S-10 Stoper is also available with tappet-type construction for shankless steel.

Three sizes of feeds are available. The S-10 can be supplied with 18, 24, and 30-inch steel changes for 7/8 and 1-inch hexagon or quarter-octagon steels, with or without collared shanks.

LE ROI Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufacturers of Cleveland air tools, Tractair, portable and stationary air compressors, and heavy-duty industrial engines. Write us for information on any of these products.

RD-83

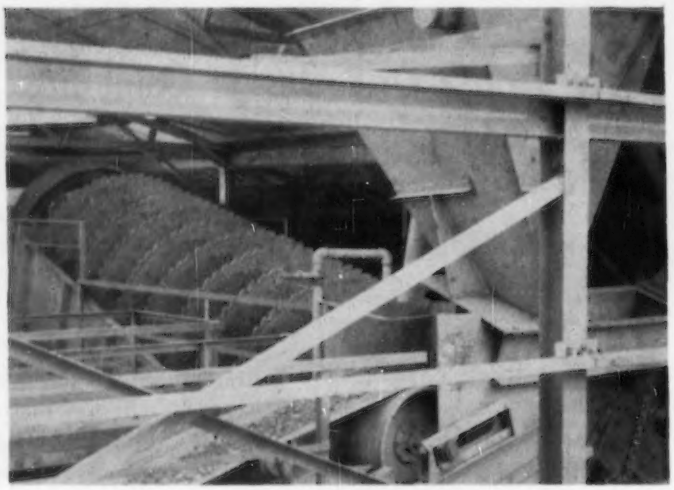
AKINS 1st in EXPERIENCE with Spiral Separators for Heavy Media

1908 . . . the first Akins. Colorado Iron Works made the first Akins Spiral Classifier in 1908. Its outstanding success led to many profitable applications and to Akins' leadership in the field of classification.

1938 . . . Heavy Media. Experimentation on the use of Akins Spiral Classifiers in making a sink and float separation was first started in 1938. Continuous research, on pilot plant and commercial scales, resulted in development of the Akins Separator . . . a modification of the classifier which retains all of the important mechanical features of the Akins. In 1944 the first 78" Akins Separator was placed in successful operation by one of the large iron mining companies.

. . . 1956

This 84" Akins Separator, installed in 1952, is typical of the many successful installations on iron ore. This unit's performance during its first year of operation resulted in the company purchasing a duplicate Separator for another of its plants. These Separators are achieving outstanding results, improving both grade and recovery through extraction of middlings . . . **taking advantage of Akins' exclusive ability to make a 3-product separation in one machine, requiring only one media circuit.**



Proved Facts about AKINS SEPARATORS

• 3-product separation in one machine, requiring only one media circuit. • Start-up under full load. • Entire vessel is visible and accessible. • Variation in rate or grade of feed is not detrimental. • Large pool area and volume minimize tramp refuse in the product and facilitate better recovery of values from fine sizes. • Gradation of gravity and viscosity from feed entry point to sink removal point provides natural cleaning of sink, and allows circulation of media at lower gravity and viscosity.

YOU can have the advantage of this AKINS EXPERIENCE just write, wire or call . . .

Akins—the ORIGINAL spiral type classifier.

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Sales Agents and Licensed Manufacturers in Foreign Countries

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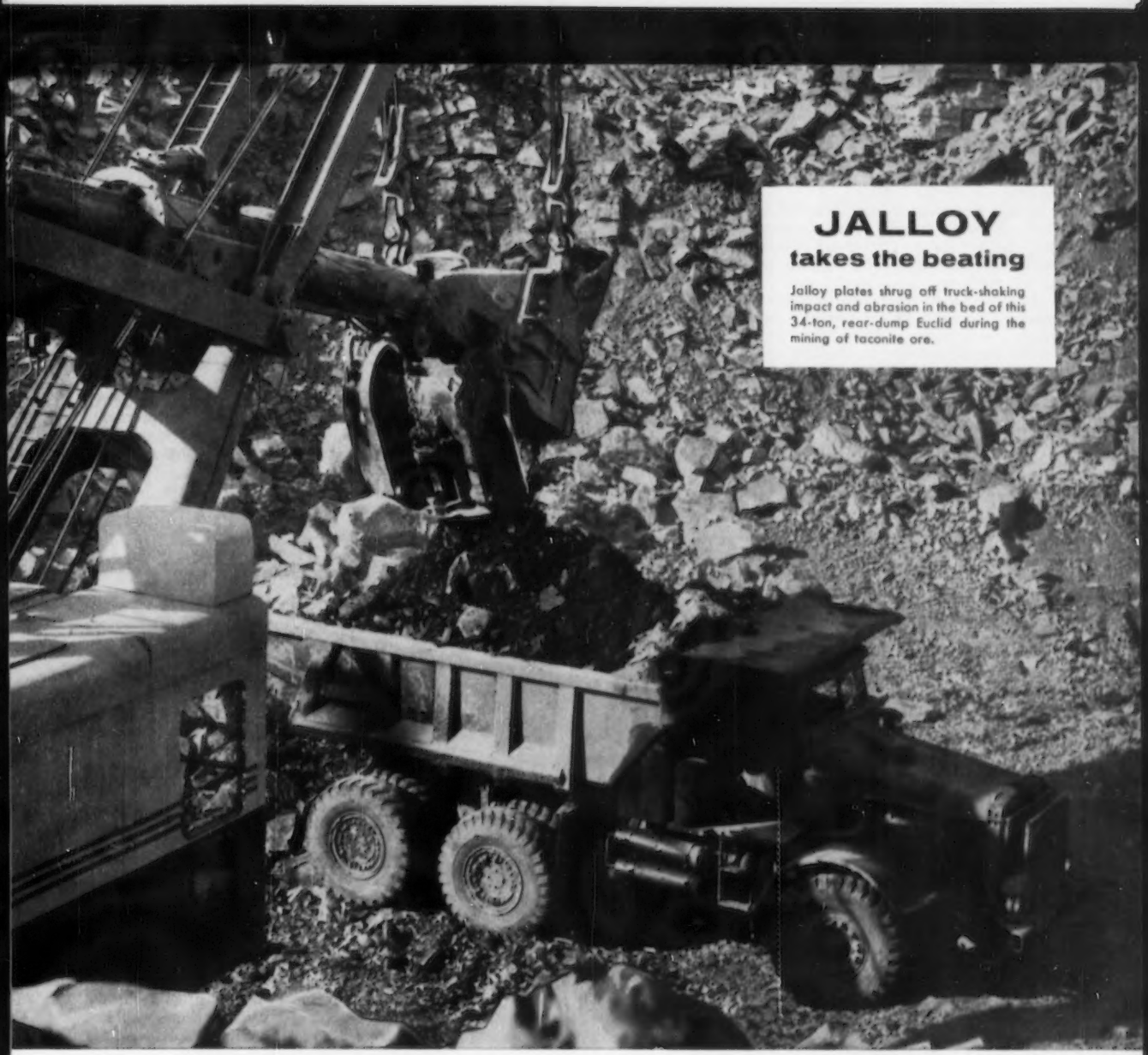

JALLOY
takes the beating

Jalloy plates shrug off truck-shaking impact and abrasion in the bed of this 34-ton, rear-dump Euclid during the mining of taconite ore.

Jalloy heat treated steels . . .

cut maintenance—give longer wear life

Jalloy—special purpose steels that are heat treated to provide longer wear on applications where impact and abrasive conditions are severe—last 4 to 20 times longer than conventional mild steels. Furthermore, they are easily welded.

Jalloy is available in three grades:

No. 1—for applications requiring excellent formability or where a low carbon alloy steel possessing good physical properties before or after heat treatment is specified. This is an ideal carbonizing grade.

No. 3—a general purpose steel capable of being heat-treated to excellent physical properties. Compared to ordinary mild steels it offers good resistance to abrasion or wear in the as-rolled state; but when heat treated to Brinell 340 and above, optimum abrasion and impact resistance is secured.

No. 7—possesses high hardness together with good ductility or wear resistance. Excellent for spring applications as well as flat work.

Jalloy high strength steels are available as plates, structurals, bar and small shape sections, hot rolled sheets, as well as strip and wire products.

Complete data concerning *Chemical Composition . . . Heat Treatment . . . Weldability . . . Physical Properties . . .* will be mailed to you promptly. Write today for your copy.

Jones & Laughlin
STEEL CORPORATION · PITTSBURGH

J&L STEEL

Wyoming *(Continued)*

even though as yet there is no AEC buying program for the new ores.

Eugene B. Hotchkiss, vice president of Vitro Corp. of America, cited Government statistics that by 1975 about 18% of the nation's power will be supplied by nuclear methods.

He said that to meet these minimum power requirements for the United States alone, a production of from 10- to 25,000,000 tons of uranium ore annually will be needed.

This does not include, he continued, the greater requirements of the rest of the world, especially of have-not power countries like Brazil and India.

Hotchkiss said, "New orebodies discovered by others in this area (central Wyoming) and promising extensions of our own indicate quite clearly that Riverton will become one of the important uranium mining centers in the country."

The 2-day convention was devoted to legal and technical panels on different phases of the mining industry.

Atomic Energy Commission has informed U. S. Sen. Joseph C. O'Mahoney (D. Wyo.) that there may be room for two mills serving Gas Hills-Crooks Gap districts of Fremont County.

The Senator said he had been advised that there was no intention whatsoever of removing the ore stockpile at Riverton portable sampler and that AEC was in negotiation with two firms seeking establishment of a mill.

Both Lucky Mc Uranium-Utah Construction Co. and Lost Creek Uranium, a firm backed by the Webb & Knapp realty interests, have been vying for a mill contract in the district.

Phelps Dodge Corp., one of the nation's largest copper mining companies, is moving swiftly in Wyoming's Fremont County uranium districts.

Wyoming Uranium Corp. announced an option deal whereby P-D would drill up to 82,000 ft on Wyoming's properties. If substantial amounts of ore are found, Wyoming would be merged into and with a proposed newly created P-D subsidiary.

Only S-D Automatics give you these 3 advantages . . .

1/4 to 1/2 TON MORE CAPACITY
Twin Latches FOR SAFE AND SURE LATCHING
SANFORD-DAY IRON WORKS
Safety Sealed AGAINST DUST LEAKAGE

THESE BOTTOM DUMPING cars dump and re-close automatically on-the-move, without extra labor, into any size surge bin. Such important features as one-quarter to one-half ton more capacity per car for the same overall dimensions are available only in S-D Automatics because of the construction advantages of our exclusive bottom dumping car design. Many are in operation in metal and non-metallic mines. It will pay you to investigate them. Also ask about our S-D Rotary, S-D Granby, S-D Rocker and other types Sanford-Day cars for replacement requirements. **SANFORD-DAY IRON WORKS, Inc., P. O. Box 1511 . . . Telephone 3-4191, Knoxville, Tennessee U.S.A**

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"SUPER MARKET FOR MINE CARS" — *all types* * PRECISION WHEELS * "BROWNIE" HOISTS, CAR RETARDERS, SPOTTERS, PUMPS AND OIL SPRAY SYSTEMS * GISMO SELF-LOADING TRANSPORT *that loads (mucks)* in development or production . . . transports . . . supports 2 to 5 jib mounted drills . . . back fills . . . moves boulder rocks . . . makes its own roadways and cleans up completely — a new method of hard rock mining offering a tremendous reduction in cost per ton!

IN CANADA

BRITISH COLUMBIA

The tremendous activity of the northern areas is expected to increase with the coming of the spring thaws. Major sections include the area just east of the Alaskan Panhandle.

Some of the new copper strikes include that of Newmont Mining Corp. of Canada, 45 miles northwest of Watson Lake; that of Hudson Bay Mining & Smelting in the area of the Iskut and Stikine Rivers, just behind the Alaska Panhandle; that of Brikon Explorations Ltd. on the Haket River northwest of Telegraph Creek.

Copper, lead and zinc have been found at head of the Hyland and Nahanni Rivers just inside the Northwest Territories by Northwestern Explorations Ltd., and Conwest Explorations has come up with an asbestos strike at Cry Lake near the Cassiar Asbestos location on McDame Creek.

The Newmont copper strike about 800 miles north of Vancouver shows widths of from 12 to 100 ft. Grab samples have run from one to 12% copper.

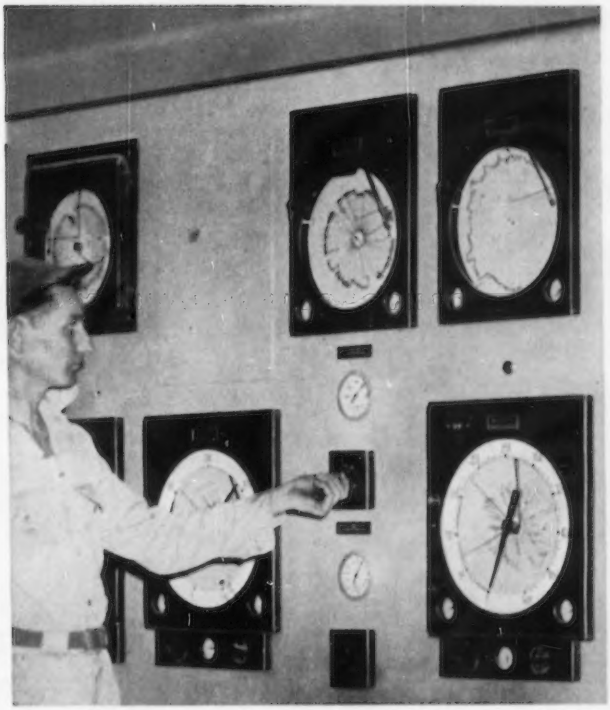
Newmont men are said to have staked some 500 claims in an area three miles long and one mile wide. Conwest Exploration has staked on each end of the Newmont ground. Other staking companies are Newkirk and Prospectors Airways.

There are plans for a 25-mile road to connect the property with the Alaska highway a short distance from Lower Post in northern B.C. From Lower Post a road is now in use to the Cassiar Asbestos property, less than 100 miles to the south.

Hudson Bay Mining & Smelting is reported to have 42 claims on the Iskut. Brikon and other companies are reported to have staked 500 claims on the Hacket River.

The Canadian Government, too, is bringing its studies on the rich northern area up to date, with the expected dispatch this summer of a big geological party from the Geological Survey Department at Ottawa. It is stated a crew of 60 will make the trek into the area by pack train, plane and helicopter.

Private enterprise has lined up all the prospectors possible, and the corps of



At the turn of a dial, the furnace operator can set the required total Btu input for a multiple-fuel open hearth furnace.

Honeywell Metered Fuel-Air Ratio Control *Saves Fuel Dollars*

Fully automatic systems cut costs on single, alternate, or combined fuel-fired installations.

HONEYWELL metered fuel-air ratio control systems on your furnaces will get the maximum Btu's from available fuel. Moreover, in addition to saving fuel dollars, these systems are designed for operating convenience.

For example, an operator can check firing conditions by merely glancing at the large, easily-read charts and scales on the *ElectroniK* controllers. With the turn of a knob, he can set up automatic Btu input control, or switch over to manual control for startup or emergency operation.

Honeywell metered fuel-air ratio control systems are, fundamentally, fuel savers, and are applicable to gas, oil, tar, pitch, air, or steam flow measurement and control. They provide direct and immediate indication of set points and ratio settings. Where panel space is limited or where graphic centralized panel operation is desirable, Honeywell miniature *Tel-O-Set* instruments can be supplied in these systems.

Each system is individually engineered to your specific furnace and fuel requirements. For a discussion of what Honeywell metered fuel-air ratio systems can do for you, call your local Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● REFERENCE DATA: Write for Data Sheets No. 4.3-4a, "Fuel-Air Ratio Control Systems"—and No. 6.4-12, "*ElectroniK* Inductance Bridge Receivers."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

48,500 Pounds of payload yet this two-trailer hopper train weighs only 29,500 pounds empty. The big capacity pays off for Motor Freight, Inc. of New Philadelphia, Ohio. This operator uses the equipment to haul coal under contract from mine to a plant 54 miles away.

Deadweight is cut by utilizing USS COR-TEN Steel, a high strength low alloy steel containing nickel, produced by United States Steel Corporation, Pittsburgh, Pa. COR-TEN provides 50% higher effective strength than structural carbon steel. Steels of this type give wide play to the skill of engineers.

62% of gross weight is payload!

Designed to utilize high strength low alloy steel containing nickel

"OUR FUTURE TRUCKS will be of the same material..." declares Robert Ress of Motor Freight, Inc.

Lightweight structures with stamina to withstand impact, battering and abrasion are readily fabricated from high strength low alloy steels containing nickel.

Also, when attacked by atmospheric corrosion, most steels of this type offer 4 to 6 times the resistance of structural carbon steel. As a result, the nickel alloyed steels retain a high degree of original strength over years of use.

Which means much more life per dollar invested.

What's more, use of high strength low alloy nickel steels increases revenue per ton mile. In either of two ways.

1. You can cut deadweight and increase payload without decreasing structural strength.
2. You can increase payload capacity without increasing total weight.

Take advantage of these modern metals. Design your equipment to earn more profit. Moderate in cost, high strength low alloy steels containing nickel along with other alloying elements are produced under a variety of trade names by leading steel companies. Learn more about these steels . . . send for a copy of "Nickel-Copper High Strength Low Alloy Steels." Do it now.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N.Y.

British Columbia (*Continued*)

geologists and engineers is beginning to make the move now the weather is favorable.

NEW BRUNSWICK

Diamond drilling has been resumed on the 120-claim property of Bagamac Mines in the Bathurst-Newcastle area. Several anomalies were indicated by a geophysical survey last year and limited diamond drilling indicated copper values. Present program is designed to follow up these indications.

Good progress is being made on construction and development at the 233-claim property of Sturgeon River Mines in the Rocky Brook section, about 12 miles northwest of Bathurst. Permanent mining plant has been installed and shaft sinking is well under way. Shaft objective is depth of 500 ft with three levels to be established to develop over 500,000 tons of silver-lead-zinc ore indicated by diamond drilling.

ONTARIO

Bicroft Uranium Mines is expected to be into production by late September this year at its uranium property in Bancroft. Construction of plant is progressing speedily. The mill is rated at 1,000-ton capacity and is designed to be boosted easily to 1,500 tons. Underground work has been confined to an adit level and a 200-ft level established from the No. 1 exploration shaft. A new main production shaft is now being sunk. Company has a government contract for purchase of $35,805,000 uranium.

First ore shipments from the Errington No. 1 underground mine of Steep Rock Iron Mines in the Steep Rock Lake area were started early in May. Upwards of 750,000 tons of the anticipated shipments of 3,250,000 tons expected to be made from Steep Rock this year, are expected from the Errington underground operation. Balance will come from the Hogarth open pit.

Pilot plant of Beaucage Mines, located some 5 miles west of North Bay, is almost completed. The flotation section is already in operation and the chemical section is expected to be in operation shortly. Research has developed a process which produces a product of 80% columbium pentoxide, well above market requirements. The process also produces a uranium product of like purity.

Diamond drilling on the lithium prospect of Dunvegan Mines in the Beardmore area, has indicated an estimated 750,000 tons averaging 1.38% lithia. This tonnage was outlined along a length of 1350 ft to a vertical depth of about 400 ft. Deposit has been delimited as to length but not to depth. Further work will be dependent on results of study currently being made of results.

QUEBEC

Rainville Mines is making plans for its second shaft at its Val d'Or area copper producer. Located one-half mile west of No. 1 shaft, the new opening will serve to develop the west half of the No. 2 zone, and test the main No. 4 zone at depth. The mill started operations April 23 and performance so far has been satisfactory. Mill capacity is in excess of 400-tpd but present hoisting facilities will probably limit production to 300 tpd. Arrangements are being made to increase hoisting facilities. Consideration is also being given to deepening the No. 1 shaft.

Diamond drilling at the Hunter property of Beattie-Duquesne Mines, 3½ miles northeast of the Beattie mill has indicated an orebody estimated to contain 2.8-million tons averaging 1.5 to 1.7% copper. The zone covers 1400 ft with widths up to 36 ft. A 3-compartment shaft is being sunk to 750 ft and it is estimated that production of ore for treatment at the Beattie mill will commence by fall.

A $7.7-million contract for construction of a large asbestos ore milling plant, capable of treating 5,000 tpd ore, has been let to F. H. McGraw Co. of Canada, Ltd., by Lake Asbestos of Quebec, Ltd., it has been announced by R. D. Bradford, presi-

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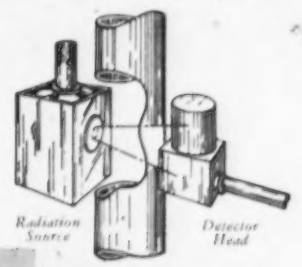

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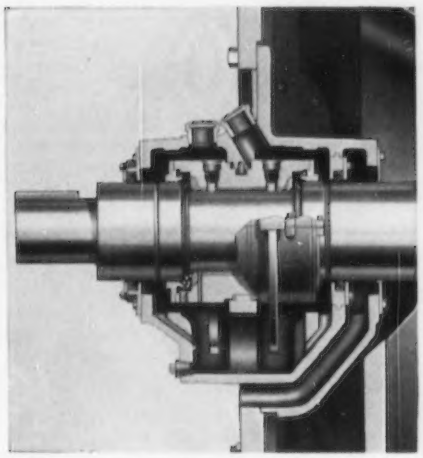
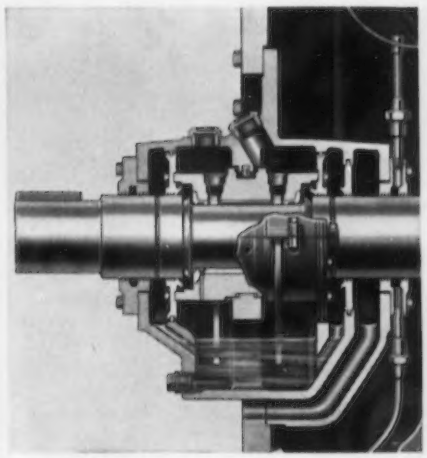


Standard capsule-type sleeve bearing



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ALLIS-CHALMERS

A-5032

Quebec *(Continued)*

dent of this wholly-owned Canadian subsidiary of American Smelting & Refining Co.

Newlund Mines is preparing to carry out one of the most widespread exploratory programs in the entire Chibougamau mining camp. Company has interests in 457 claims in 10 townships and work is actively proceeding or planned on all of them. Holdings include 10 wholly-owned groups on which geophysical surveys are under way or soon to be started.

Normetal Mining Corp. is planning to start preparatory work for a new internal shaft later this year. Shaft will be put down to open up a further block, 1,000 ft below the present bottom, or 5,365-ft level. It is expected that it will take at least two years to open up the new block of ground.

MANITOBA

Copper-Man Mines in recent drilling on its Herb Lake property intersected a well mineralized zone between 653.5 and 665.5 ft averaging 1.88% copper and 2.5% zinc. The main zone containing 115,000 tons of ore averaging 3.1% copper was drilled to a depth of 550 ft. The recent drill intersection is believed to indicate the downward extension of the main ore zone.

Green Bay Mining & Exploration reports that 42 claims have been optioned near Hammell Lake about 3 miles northwest of Flin Flon.

A new company, Lithia Mines & Chemicals, has been formed to acquire the lithium property held by Violamac Mines in the Cat Lake area. A contract for hydro power has been signed and a road is being built to the mine site.

Mining Recorder's Office at The Pas filed over 2,000 mining claims during the month of March. Heaviest staking was in the Paint and Mystery Lake area.

New Manitoba Gold Mines has outlined an estimated 1.2-million tons of ore grading 0.65% copper and 0.23% nickel on its Cat Lake property. Metallurgical tests indicate a bulk nickel-copper concentrate can be produced with a recovery of 96% of the values. Company is planning to sink a 3-compartment shaft to a depth of 650 ft.

SASKATCHEWAN

An ore estimate established by drifting on the first, 170-ft level and outlined by diamond drilling at Cayzor Athabaska Mines is given as 818 tons per vertical foot averaging a reported 0.4861% uranium oxide, according to the company's consulting engineer, H. T. Leslie.

Cayzor has contracted to ship its ore to the new custom mill to be built by Larado Uranium Mines in the Beaverlodge area of northwestern Saskatchewan. The company expects to produce 300 tpd.

Its property is 1¼ miles from Uranium City.

A vertical 3-compartment shaft has been sunk to 350 ft with levels at 170 ft and 320 ft. Lateral development to date on the first level amounts to about 3200 ft in cross-cutting and drifting and on the second level to about 690 ft.

A total of 109 diamond drill holes was completed on the property, most of them along the fracture and shear zones on the southeast side of Jean lake.

IN LATIN AMERICA

CHILE

Compañía Minera Mantos Blancos whose copper mine is located near the port of Antofagasta, asked permission from the government to bring into the country $6.5-million in accordance with the new tax law which allows fresh capital invested in copper mining a faster write-off and reduced taxation. Part of this sum will be brought into the country as machinery and part in dollars to pay for wages and local construction materials. A 1,000-tpd leaching plant will be built at the mine which will produce 6,500 tons fine copper per year.

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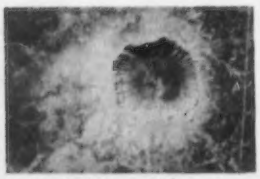

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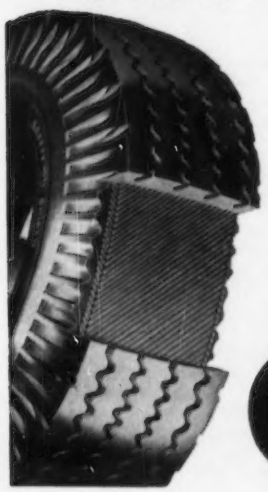

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Chile *(Continued)*

Mining Credit Bank has increased its lead ore-buying schedules 80% in accordance with the Administration decision to allow a free rate of exchange which has already begun to function.

Argentine will buy 6,000 tons of copper from Chile in various shapes and in accordance with the commercial treaty between the two countries.

Governments of the U.S. and Chile have ratified and perfected an agreement signed last year in Washington dealing with atomic energy subjects. As per this agreement, the U.S. will send to Chile for a two-year period geologists specialized in radioactive minerals who will investigate known uranium deposits and will look for new ones.

Mining Society of Chile has been discussing and studying the possibilities of increasing the sources of electric power to the mining industries both in central and northern Chile. It is possible that the government agency (ENDESA) that has been building Chile's power plants may get a $35-million dollar loan from the ExImbank to carry on its program of hydroelectric power development.

IN AUSTRALIA

Australian Government is extending its gold subsidy scheme for another three years. Conditions relating to subsidy payments will remain essentially unchanged and it is expected that the continuation of the subsidy will enable several producers to stay in the field. The government is still hopeful that the price of gold will be increased in the not too distant future and would like to maintain the gold output on a relatively high level.

Department of National Development began a detailed aerial magnetometer survey for iron ore deposits in East Gippsland, Victoria. Search is concentrating on an area of about 360 sq miles between Nowa Nowa and Buchan. Ground surveys which followed previous aerial surveys resulted in discovery of iron ore deposits, but their economic importance remains to be determined.

Western Uranium Mines N.L. will establish a copper treatment plant at Ravensthorpe in Western Australia. The plant, designed for the production of copper concentrates, will have a throughput rate of 5,000 tons of ore per four-week period. Latest reports from Western Uranium claim that it had intersected a lode at a depth of 600 ft.

U. S. Government, which has a purchase contract with King Island Scheelite Ltd. is not interested in extending the validity of the purchase agreement. The U. K. purchase contract is expiring in the immediate future but the American contract will be in existence for another two years. Contracts provide for purchases of tung-

(Continued p 188)

RESEARCH

ON ORES AND MINERAL PRODUCTS

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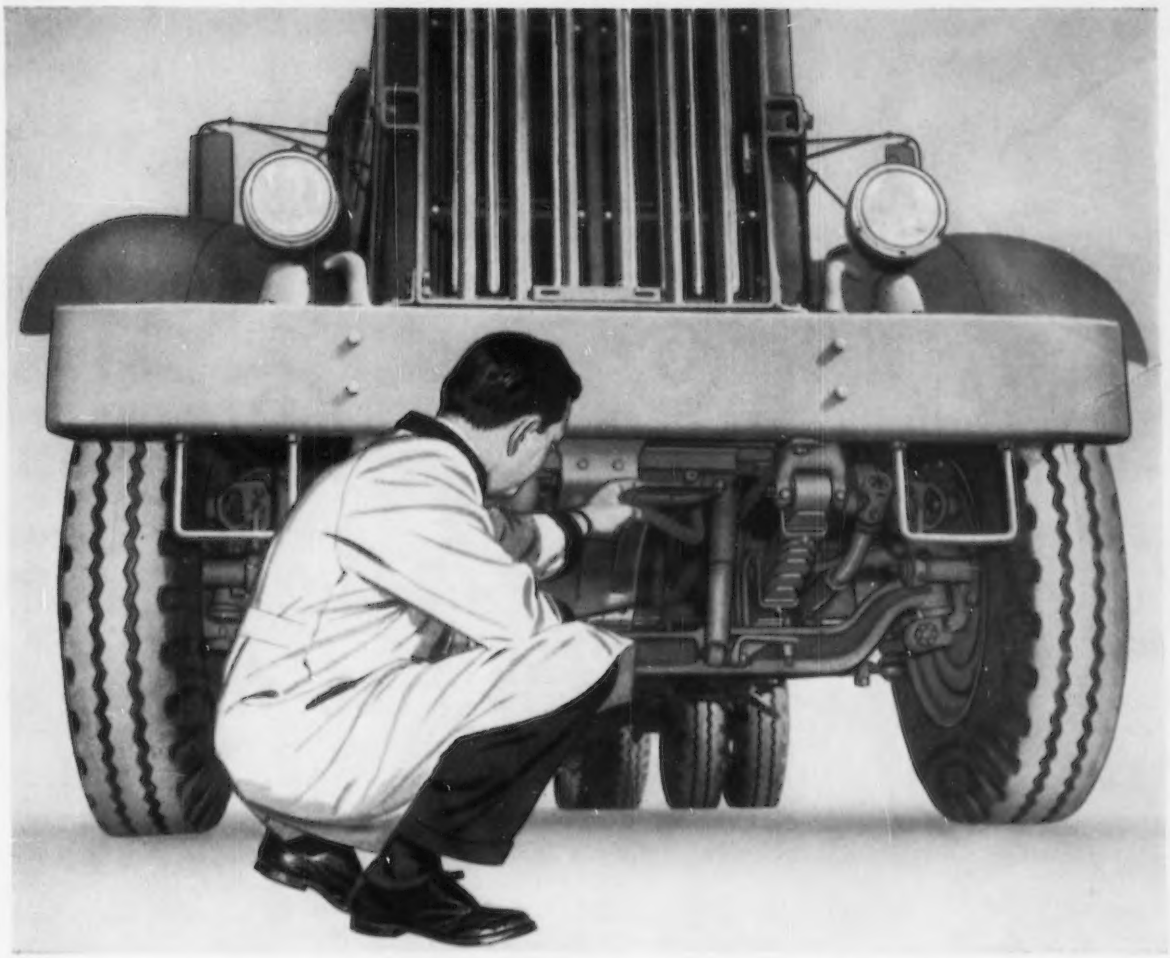

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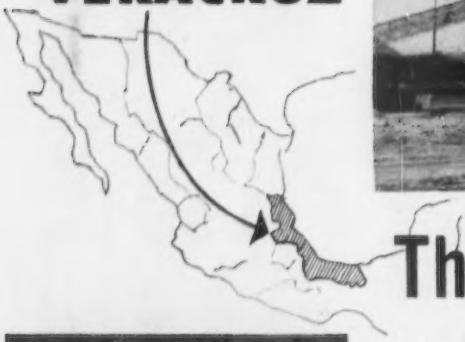

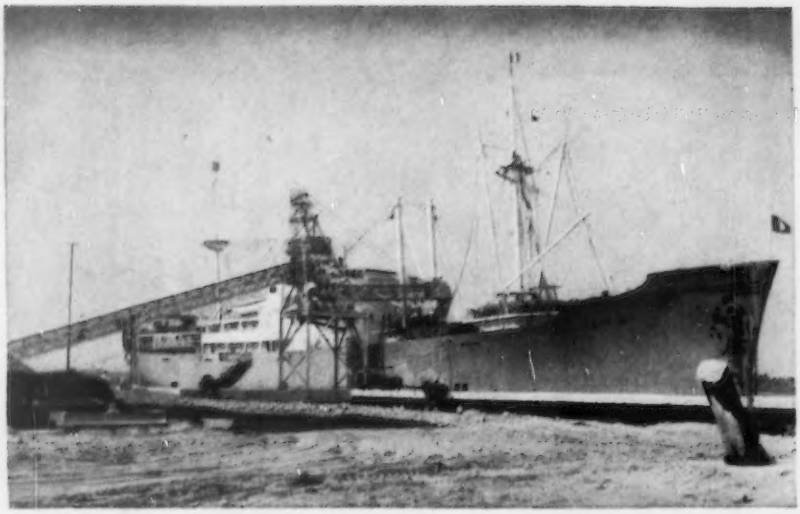

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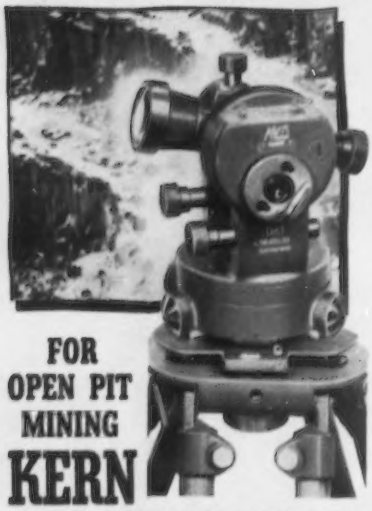

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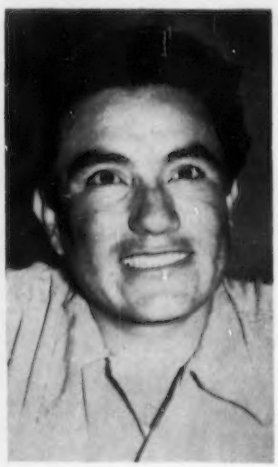
IRON MOUNTAIN stands near historic Mexican city of Durango, rises some 700 ft.

ORE is loaded at Fierro del Norte by Cat No. 6, hauled to railway by truck.



MANAGER Miguel Celestino (right) supervises a 1,000-tpd ore program.

Three Companies Tap Cerro de Mercado Iron

IRON MINING ACTIVITY at Mexico's famed Cerro de Mercado, near the city of Durango, is surging ahead. Besides the newly modernized operation of Cerro de Mercado, on the north of the iron mountain (*E&MJ*, January 1956, p 94) Cia. Fierro del Norte and Cia. Fierro de Durango are also beginning to remove large tonnages.

Miguel Celestino, manager of Fierro del Norte, is directing operations for his firm at the 700-ft high mountain which is said to consist almost entirely of iron in various stages of oxidation. Using a Caterpillar No. 6 Traxcavator, Celestino's crew loads some 1,000 tpd ore (70%Fe) for transportation to railway by truck. Ore is hematite, averages 60 to 67% over all. Fierro del Norte's deposit is said to extend for nearly one mile, with a width of 2,000 ft. Depth is still unknown.

Fierro de Durango, smallest of the three, currently uses an HT4 to dig float iron for loading into dump trucks and transportation to the Mexico City-Juarez railway. Later they will work open pit. Float iron reportedly grades 58% iron, open pit 62%. Output now stands at about 500 tons per 8-hour day.

Australia *(Continued)*

sten at a price considerably above present-day world prices. It is probable that King Island Scheelite Ltd. will enter into another contract agreement at a price closer to present levels with a provision for price fluctuations tied to world price movements. Company hopes to be able to operate at lower cost thanks to its extension and modernization program and is also considering an investment in other mining ventures.

Northern Uranium Development N. L. and Uranium Mines N. L. have discovered more high grade pitchblend at the El Sharana mine. The companies have also obtained approval to prospect a new area

(Continued p 194)

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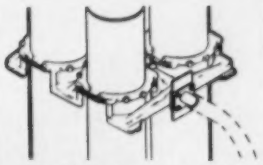

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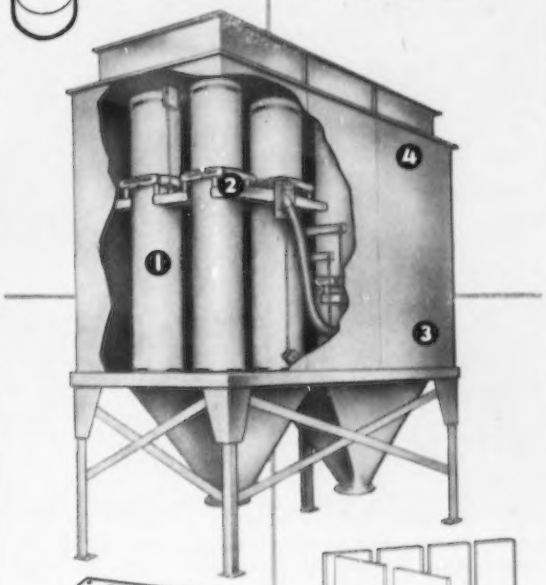
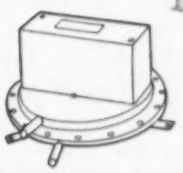
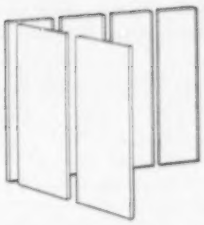




3 Automatic pressure switch* eliminates overcleaning . . . prolongs bag life. Switch controls blow ring operation. Above normal pressure loss actuates rings which stop when pressure loss normalizes. Automatic self-cleaning occurs as often or as seldom as needed.



4 Prefabricated Aeroturn can be installed in one-quarter the time required by ordinary dust collectors of similar capacity . . . in half the space. Aeroturn arrives from the factory in easy-to-assemble prefabricated sections.

50% LOWER MAINTENANCE COSTS and 99.9%+ EFFICIENCY

with KOPPERS Series 12 Aeroturn Dust Collectors

Up To 75% Lower Installation Costs . . . Up to 50% Less Space! You can get rid of dollar-consuming dust far more economically with a Koppers Series 12 Aeroturn than with a conventional collector. The Aeroturn Dust Collector costs you less to install and maintain . . . occupies far less space. A Koppers Series 12 Aeroturn operates continuously and automatically at highest filtering efficiency.

Aeroturn's remarkably high filtering efficiency sends your plant and machinery maintenance costs way down. Your heating and cooling costs fall because you can recirculate air . . . cleaner than outside air. Koppers Series 12 Aeroturn Dust Collector is available with from 4 to 64 filter bags . . . Aeroturn's capacities range from 1,000 to 60,000 CFM. It only takes a few minutes of your time to discover for yourself the many cost-saving features of the Koppers Series 12 Aeroturn.

Factory-assembled and test-operated, Koppers Model D Aeroturn Dust Collector combines features of Series 12 with unusual compactness. Capacities range from 500 to 4,800 CFM.

AEROTURN DUST COLLECTORS

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Koppers Company, Inc.
Metal Products Division
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***Engineered* Products**
Sold with *Service*

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KOPPERS COMPANY, INC., Industrial Gas Cleaning Dept., 5206 Scott Street, Baltimore 3, Maryland.

Gentlemen: Please send me a free copy of your Aeroturn Booklet with descriptions, drawings and photographs. ☐ Series 12 ☐ Model D

Name ..... Title .....

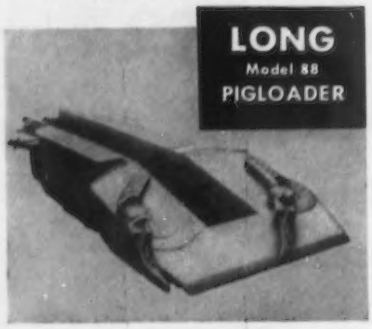
Company .....

Address .....

City ..... Zone ..... State .....

Designed To Outperform
Anything On The Market...

Two Great
LONG
Loaders



A low height, heavy-duty machine capable of continuous high-capacity operation, the LONG Model 88 Pigloader*, has been developed specifically for Piggyback* Conveyor Mining. It's built extra rugged to withstand hard usage, yet is readily maneuverable and simple to operate. Rated capacity: average—4 tons per minute; maximum—6 tons per minute. Height 26".

Equipped with a swing boom for loading into shuttle cars, this new loader offers the same superior operating features as the Model 88. Extensive operating tests indicate that the Model 188 will outperform any loader in its class on the market today. Rated capacity: average—4 tons per minute; maximum—6 tons per minute. Height—28".

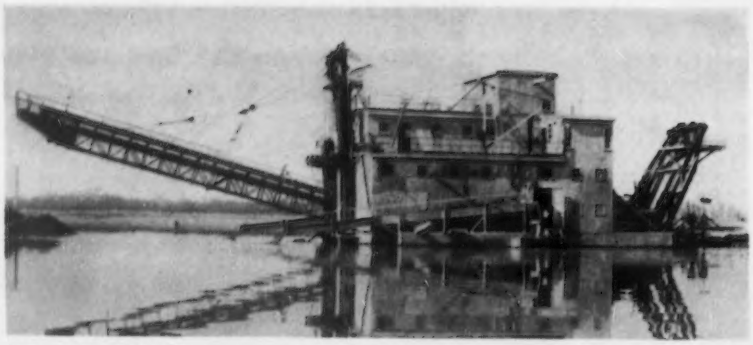
*Trade Mark

The LONG Design Features A Single 40 hp Electric Motor

- Simplicity of electrical circuit
- Less maintenance
- Permits full power for any single machine operation

For complete details or a demonstration, write us today.

The LONG Company
OAK HILL, W. Va.



NO. 146 DREDGE, veteran of California operations, will be reconditioned for Korean mining conditions and placed in operation at Taechon-ni, north of Mokpo.

OLD HAND METHODS, with workers carrying gold-bearing gravel on their backs to the sluice, will be abandoned with arrival of the 720-ton dredge from Yuba Mfg. Co.

Yuba's Dredge Revises Korean Gold Methods

A GOLD PLACER mining operation on Korea's southwest coast will switch from hand mining methods to dredging late this year when Yuba Manufacturing Co., San Francisco, completes delivery of a 720-ton dredge.

Yuba sales director C. M. Romanowitz, just back from a tour of Korean gold operations, said the dredge will be used at a property 37 miles north of Mokpo. Located on an estuary which drains into the Yellow Sea, it is partially on tideland.

Value of the reserves has been estimated at $3,350,000. The gravel has been worked by hand for several years. The Japanese worked it before the war.

Upper portion of the workings is protected by an earth fill dam built in 1952. Most of the property is on seaward side of the dam, however, and it is flooded at high tide. The gold occurs in gravel strata below silty clay.

Purchase of the dredge was made possible by the United Nations Korean Reconstruction Agency, who advanced a loan to cover its cost—$521,500.

The dredge will be dismantled for shipment, then erected on the site under the direction of a five-man team from Yuba. The team also will train Korean personnel to operate it.

Yuba will modify the dredge for needs of the Korean operation, located at Taechon-ni. Digging depth will be increased from 26 to 40 ft and spuds will be removed to allow headline digging for better control in the sandy soil. The dredge has a steel pontoon hull 112 ft long and a bucket line of 90 buckets with capacity of 6 cu ft each. Gold-saving tables form the recovery system.

The dredge is one of seven now idle that formerly were used by Yuba's parent company, Yuba Consolidated Gold Fields, in dredging operations at Hammonton, Calif.

Arrival of the dredge in Korea will reactivate gold dredging in that nation. Before World War II, four Yuba dredges were in operation in Korea, but they reportedly were melted down for war materials.

The Korean operating company at Taechon-ni is headed by Louis Yim, a University of Southern California graduate, former first minister of industry and commerce for the ROK Government and one-time Korean representative to the United Nations. Pak Sei Cum is vice president. The firm is headquartered in Seoul.

CABLE AND MINE EXPERIENCE enable Anaconda to design and build shovel cable that resists razor-sharp rocks, water, sun, heat, cold, and — most important — run-overs.

This cable was "built" in our mines to perform better in yours

If you were a cable manufacturer as well as a miner, you could use your mine experience to build cable better than others.

But since you aren't, it will pay you to buy your cable from Anaconda—who *is* both cable manufacturer *and miner.*

FOR SHOVEL CABLE

Years of mine experience . . . of cable testing and improving . . . have taught us how to make a cable that *stays on the job longer under all conditions.* It's Securityflex* Type SH-D cable.

New, job-tested, high-grade butyl insulation assures better resistance to heat, water and compression. And new neoprene jacket makes this cable even tougher and more abrasion-resistant.

For Type SH-D, *or other shovel cable,* let Anaconda mine and cable experience pay off for you. See your Anaconda Distributor. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 66021

*Trade Mark

ANACONDA®
MINE CABLE

FLAT-TWIN CABLE

Improved stranding, new insulation, new grounding wire, and neoprene jacket make this a superior cable for shuttle cars, continuous miners, loaders, drill trucks, cutters.

POWER CABLES

AnacondA Types W & G are rugged, sturdy and long-lived. Used for mine power, shovels, continuous miners, loaders, drill trucks, cutters.

SHOVEL AND DRILL CABLES

Securityflex* Types W and G are used with small shovels, self-propelled drill trucks, pumps and a-c mining equipment. For higher voltages, Type SH cables (shielded) are recommended.

SECURITYFLEX CORDS

Unexcelled for strength, wear resistance and long life. Type SO (heavy-duty) provides superior service on remote control and hand drills.

TROLLEY WIRE

FEEDER CABLE BARE OR INSULATED

TELEPHONE WIRE

SHOT-FIRE CORD

WELDING CABLE

Telsmith Jaw Crushers minimize maintenance costs *with* TISCO MANGANESE STEEL

TISCO Manganese Steel Jaw Plates are used in Telsmith Roller Bearing Jaw Crushers, manufactured by Smith Engineering Works, of Milwaukee.

In this type of equipment all parts in contact with the material must withstand exceedingly destructive wearing action. High Manganese Steel, first introduced by Taylor-Wharton more than sixty years ago, best resists the heavy combination of impact and abrasion characteristics of crushing operations. The use of jaw plates of TISCO Manganese Steel in Telsmith Crushers substantially reduces maintenance costs.

Although manganese steel is still unsurpassed in its resistance to impact and abrasion, it is supplemented today by other TISCO alloys for special wear problems. TISCO 150-Y, for example, gives exceptionally good results where severe abrasion, without much impact, is the principal wear factor. It is used for scraper blades, agitator blades, augers, mixer paddles and similar applications.

TISCO #50 is another useful alloy with strong resistance to abrasion and fair impact qualities. It is recommended for ball and rod mill liners, bushings and other uses that have this type of wear condition.

If abrasion, impact, or a combination of both, are operational problems with you, consult Taylor-Wharton.

Use TIMANG Weld Rods and Shapes for rebuilding and repairing worn parts made of Manganese Steel.

TW

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DIVISION OF HARSCO CORPORATION

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Birmingham, Ala. Chicago, Ill. Cincinnati, O. Easton, Pa. New York, N.Y.

B.F.Goodrich

PENNSYLVANIA coal hauler gets 6,000 hours' service from BFG tires.

VIRGINIA miner reports BFG tires can be recapped where others failed.

MINNESOTA iron miner finds BFG tires defy chunks of abrasive rock.

KANSAS miner uses BFG tires to pull 80-ton "hopper cars" out of pits.

These miners save money with BFG tires —here's how you can, too!

A PENNSYLVANIA coal stripper reports B. F. Goodrich Universal tires have given 6,000 hours of service, including recaps. Tire trouble at a Virginia mine used to stop production, run up costs. Then the company switched to BFG tires, now reports their tire problems licked. On a Minnesota ore road or pulling out of a Kansas open pit, B. F. Goodrich tires defy dangerous rock cuts.

These reports are typical of what mine operators all over the country find: B. F. Goodrich tires wear longer and reduce operating costs. Extra-thick tread on the Universal resists cuts and bruises. And under the tread is the B. F. Goodrich *all-nylon* cord body.

Nylon is stronger than ordinary cord materials, withstands double the impact and defies heat blowouts and flex breaks. That's why the B. F. Goodrich *all-nylon* cord body outwears even an extra-thick tread, *can still be recapped over and over.*

Your B. F. Goodrich retailer has a tire for every kind of mine work. Let him show you the one that will wear longer and save you money. Or write *B. F. Goodrich Tire & Equipment Company, a Division of The B. F. Goodrich Company, Akron 18, Ohio.*

Specify B. F. Goodrich tires when ordering new equipment

B.F.Goodrich
FIRST IN RUBBER

Your B. F. Goodrich retailer is listed under Tires in the Yellow Pages of your phone book

A satisfied customer writes about Joy

LIMBEROLLER

Belt Conveyor Idlers:

"Early in 1955 we decided to try four Joy Limberollers on the No. 1 slope conveyor from the primary gyratory crusher in the quarry.

"This conveyor carries the product of the primary crusher set at about 5′, on a 12 degree slope and running at about 450 feet per minute. Originally designed for 400 ton per hour capacity; there have been surge loadings of twice this amount.

"While the balance of the conveyor system is the enclosed gallery type; the No. 1 slope conveyor was not fully completed before the start of production season and consequently ran all year exposed to all kinds of weather.

"The Limberollers have carried a few hundred thousand tons of heavy stone with absolutely no maintenance. On the basis of this record we have placed repeat orders."

Richard Robinson

Richard Robinson, Treasurer
MASSACHUSETTS BROKEN STONE COMPANY

LIMBEROLLERS, at work on conveyor at Massachusetts Broken Stone Company.

The Joy Limberoller resists dust, abrasion, corrosion and material buildup. Resilient discs on a flexible steel cable conform to load and cushion the belt. Only two bearings are used and these are up out of the dirt zone. Get details from *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

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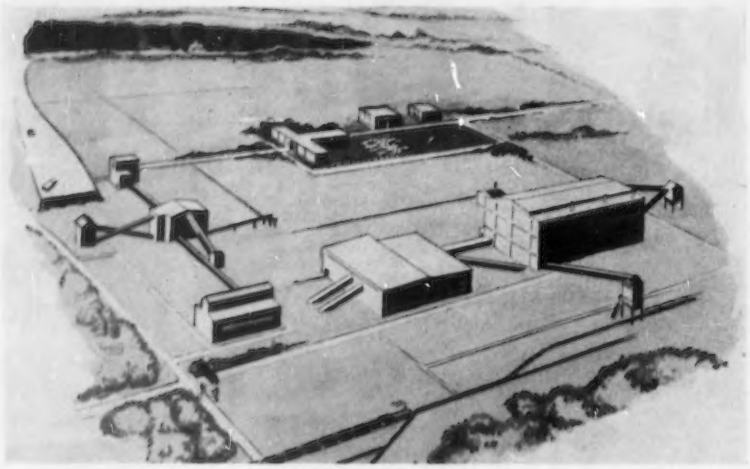


NEW PLANT, set for completion in 1958, will crush, grind, separate and pelletize magnetite ores from the former Bristol mines, whose life is set at about 15 years.

Hilton Mines Will Pelletize Ontario Ores

COMPLETION of construction, due in 1958, will presage an annual output of some 60,000 tons of pellets per year from the Hilton Mines, located 40 miles northwest of Ottawa. Formerly called the Bristol Mine (*E&MJ*, April 1956, p 122), the property has been named after H. G. Hilton, president of Steel Co. of Canada, Ltd. which shares ownership of the mine through its subsidiary, Stelco Mines, Quebec, Ltd., with Bristol-Quebec Mining Co., Ltd. Latter firm is jointly owned by Jones & Laughlin Steel Corp. and Pickands, Mather & Co.

Some 15 years' supply is seen from the orebody, a low-grade magnetite deposit. Mining will be by open pit with processing to follow the general methods employed at the taconite operations in the Iron Country and at Bethlehem's mine at Marmora (*E&MJ*, July 1955, p 75).

Procedure includes: stripping with 4½-cu yd shovels; haulage in 22-ton trucks; drilling and breaking to maximum 3½ ft; primary crushing; secondary to minus 2-in.; tertiary to 1-in.; ground in rod and ball mills; through magnetic separators and cone classifiers; dewatered (to 9% moisture) in disk filters; mixed with bonding material and coal; balled; fired; stored and shipped.

Final pellets are expected to show 66.2% Fe, 3% SiO_2, 0.006% P and 0.11% Mn. About one-half will be shipped to Hamilton for eventual return to Quebec steel processing plants. The rest will go to U. S. facilities.

Australia (*Continued*)

of about 270 square miles at South Alligator River. The prospecting will be a joint venture with North Australian Uranium Corp. N. L. At El Sharana, pitchblende is showing freely in the east drive of the 100-ft level.

Morning Star Mines N. L. intends to develop three major reefs intersected by the inclined shaft at the Wood's Point Mine. Development of the reefs below No. 19 level will begin in August 1956. The stoppage of shaft sinking was decided on because of the recent discovery of a large quartz reef between No. 23 and 24 levels.

Mining Corporation (Austr.) N. L.'s diamond drilling operations on the Mt. Isa line of lode lease has advanced to a depth of 918 ft. Diamond drilling is also proceeding satisfactorily on the Mt. Cobalt leases where hole No. 8 completed at 316 ft intersected the deposit. Hole No. 9 has now reached 118 ft. Underground examination will commence in the near future.

North Australian Uranium Corp. N. L. has been granted an authority to prospect an area of about 2,000 square miles in the Northern Territory. The area is in the Calvert Hills and Pandanus Creek districts and the location was selected by Dr. R. E. Wimber, chief geologist of Atlas Corp. of U. S. on his last visit to Australia.

IN AFRICA

Drilling operations have started near Gatooma, Southern Rhodesia, for uranium and associated minerals by Central African Exploration Co. Besides the 50-square mile area now being prospected, the firm owns other prospecting rights nearby and in the Sinoia district.

Rio Tinto Co., through Mineral Search of Africa, Ltd., is drilling on a 3,000-acre claim near Gatooma for nickel. Acquiring option reportedly cost some $1.25-million.

Tripled lithium salt production is coming from the plant at Gwelo, Southern Rhodesia. Some $200,000 was spent recon-

(*Continued p 196*)

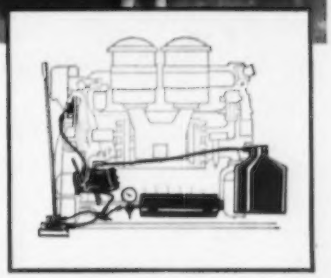
It takes a power shovel

half a second to dump a bucket

But a Hydrostarter starts a GM Detroit Diesel in

One-Third the Time

Heart of the Hydrostarter is this hydraulic starting motor. Other components are an engine-driven pump, accumulator, emergency hand pump and reservoir.



15/100 of a second. That's the split-second it takes a Hydrostarter to start a General Motors Detroit Diesel. And a Hydrostarter cuts your operating costs—costs less to maintain even than regular starting systems. In a recent 26-day test one Hydrostarter started a GM Detroit Diesel 26,788 times. For sure, fast starts even at 20° below zero, specify a Hydrostarter on your next GM Detroit Diesel—or have one installed on your present engine. For more information call your GM Detroit Diesel distributor, dealer or write direct.

DETROIT DIESEL

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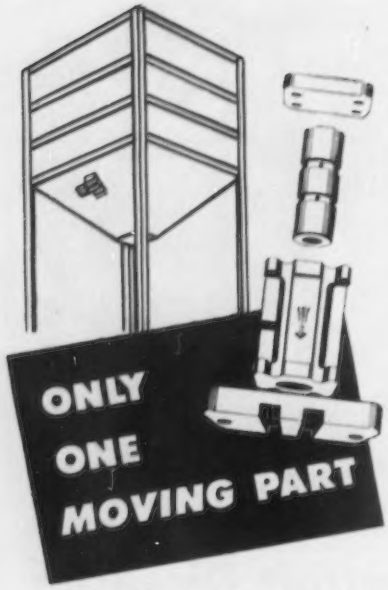
Single Engines . . . 30 to 300 H.P. Multiple Units . . . Up to 893 H.P.

AMERICA'S LARGEST BUILDER OF DIESEL ENGINES



on this Bin Vibrator

That's the secret of the Cleveland Air Vibrator record of low maintenance costs. There's little to wear out. A simple mechanism, manufactured to precision standards, and subjected to exacting inspection. There just isn't a better combination for a long, trouble-free life. Write for complete information.

Air or Electric
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Noiseless or standard

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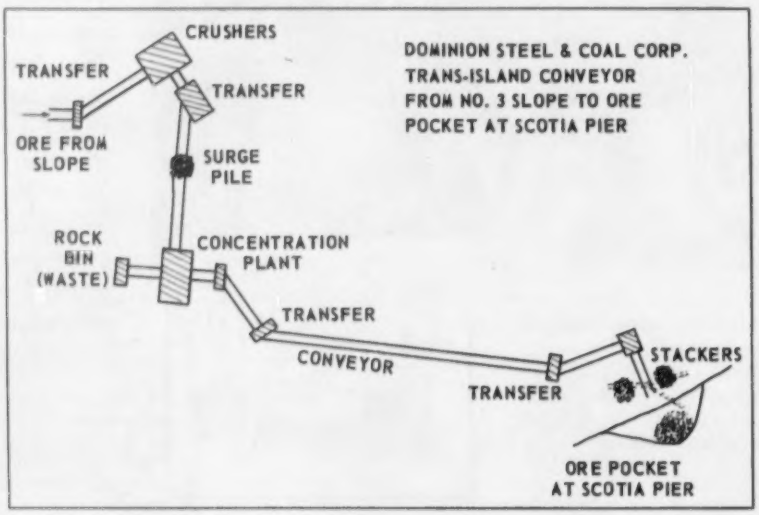
WABANA ORE crosses Bell Island on conveyor sections at 550 fpm. Longest jump runs from Tank Hill to hilltop near loading bins at Scotia Pier; a distance of 4,528 ft.

Wabana Ore Crosses an Island on Conveyors

A 9,000-FT conveyor system installed at St. John's, Newfoundland transports complete iron ore output from the Wabana mine to Scotia Pier. System, designed and installed by Stephens-Adamson Manufacturing Co., consists of a series of continuous belts with 1,000-tph capacity, traveling at 550 fpm.

Dominion Steel & Coal Corp. moves its ore from the former truck loading bins at No. 3 mine to a 7,000-ton surge pile; from there to a heavy media separation plant; to loading bins at the pier via one 4,528-ft section. A conveyor stacker at the pier site fills the bins and stockpiles surplus. New belt and conveyor, replacing truck haulage, are part of a $15-million expansion and improvement program. Concentrator capacity is sufficient to handle total output of the mine, now said to be approximately 2-million tons per year.



Africa *(Continued)*

ditioning and re-equipping the old plant, which handles ore from the Fort Victoria district.

Companhia Mineira Lusodala SARL and Empresa de Cobre de Angola have been granted prospecting permits in the Portugese possession of Angola. Both firms have signed agreements paying percentages of profit from all minerals mined.

Production of 8,000 tons of titanium oxide annually will commence in 1958 from a joint venture of African Explosives & Chemical Industries and British Titan Products, who will spend $5.5-million on the Natal project.

Factory will be attached to the explosives concern's plant at Umbogentweni, which produces sulphuric acid, used in leaching the mineral. Main source of raw material will be ilmenite from nearby beach sands.

Early June saw commencement of a new copper, gold and silver mine, owned by

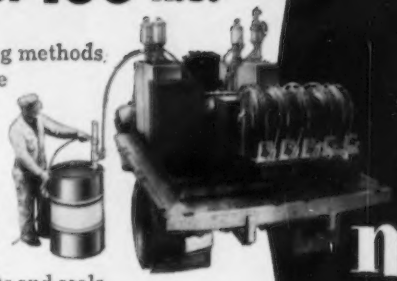
1. Alemite Loader Pumps . . .

save 3¾ man-hours for every 100 lbs. of grease!

Alemite Loader Pumps put an end to slow, messy, hand loading of grease guns. They make sure *clean* grease is delivered to bearings, free of dust and grit that can cause a costly breakdown. Just a few strokes fill the gun with refinery-fresh lubricant. Models to fit and seal any original container—from a 400 lb. drum to a 25 lb. pail. Shown: Model 7181-L "Red-A" Loader Pump.

2. Alemite Power Transferring . . .

saves up to 63% of man-hours per 100 lbs.



Alemite *Power* transferring methods save important time—give vital protection! Here an air-operated Alemite Gusher Pump, Model 7216-A, refills lubricant tanks on a portable service station . . . transfers 37 pounds of pressure gun grease in just 60 seconds! Fits and seals original refinery drum . . . completely protects lubricant every step of the way!

3. Alemite Portable Service Stations . . .

save up to 95 man-hours for every 400 lbs. of grease!

Bring all the advantages of a complete lubrication department right to equipment in the field! No time lost—no more costly breakdowns due to improper or insufficient lubrication. Portable Service Stations provide all standard maintenance services—pressure gun grease, gear lube, oil, air and water. Save time, money, equipment!

Proof!

Alemite lubrication methods save time...money ...equipment!

Alemite In-The-Field Lubrication helps meet tight time schedules ...saves three ways!

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Gentlemen: Please send me FREE information on Alemite lubrication methods that can save me money, plus FREE illustrated booklet on Alemite Portable Service Station and Alemite Equipment.

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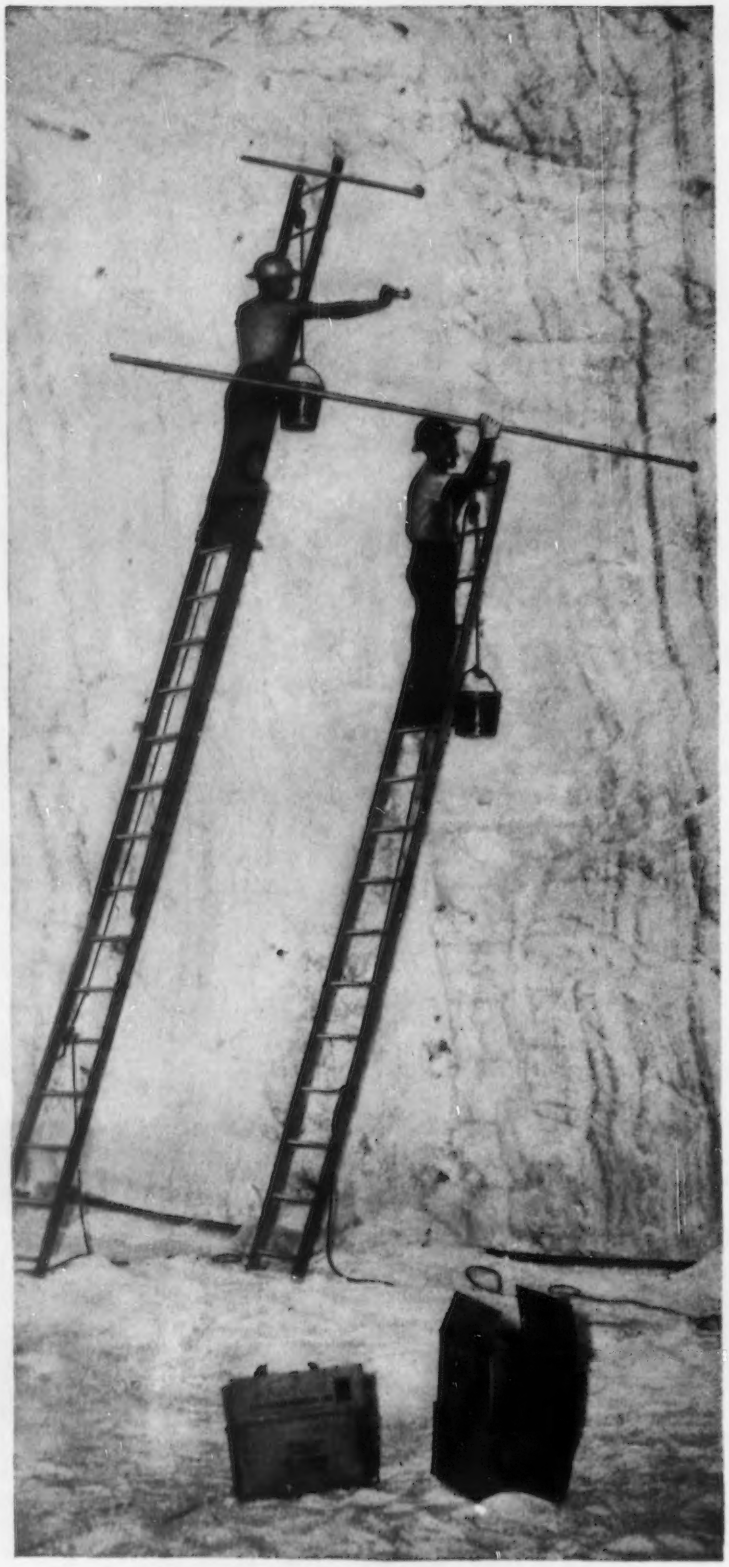
Mining Rock Salt 1000 Ft. Underground

WHERE EXPLOSIVES RESEARCH PAYS OFF



Using ladders, the blasting crew loads cartridges of Hercomite® into the upper rows of drill holes in a 24-ft. high working face 1,000 ft. underground in Jefferson Salt Company's mine in Louisiana.

Primed with regular and short-period delay electric blasting caps made by Hercules, the blasts produce excellent fragmentation, affording economical recovery by power shovels and uninterrupted processing operations in the plant on the surface.

The development, manufacture, and use of specialized types of explosives have been Hercules' business for over forty years. Our knowledge of explosives and blasting techniques is at your disposal in solving blasting problems in mining, quarrying, construction, or wherever explosives are used.

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4855-6

One of the 6 dredges offered. Digging depths range from 35′ to 80′ below water level; buckets from 8½ to 18 cu. ft.

6 YUBA DREDGES

AVAILABLE FOR PRACTICAL PROJECTS

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Platinum	Gold	Titanium
Monazite	Chromium	Zirconium
Tungsten	Garnets	Sapphires
Diamonds	Thorium	Uranium

Tin... and other minerals found in placer deposits.

Or Use for Such Construction Projects as...

Erecting flood control levees
Changing stream channels
Building canals and cofferdams
Excavating diversion channels
Producing aggregate
Working beach sands

Money and Time Saving Possibilities

You can put any of these dredges to work on your project many months earlier than a new outfit... and certainly at decided savings in costs.

All 6 dredges have been proved in gold field operation and are available only because ground is worked out. They can be remodeled to meet your exact work needs.

Extremely Flexible Terms

You'll find us easy to deal with. If you're a responsible person with worthwhile projects, we'll be happy to discuss royalties, lease, stock participation or other highly flexible, mutually agreeable terms.

Don't Delay!

Don't delay. Take advantage now of this opportunity to get a job-proved dredge, at big savings, on extremely flexible terms. Fill in coupon and mail TODAY for your copy of 8-page folder picturing and describing these 6 Yuba Dredges.

YUBA CONSOLIDATED GOLD FIELDS

351 California St., San Francisco 4, Calif.

G-103

Yuba Consolidated Gold Fields
351 California St., San Francisco 4, Calif.

I'm interested in a dredge for mining or excavating _____

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Please send folder "6 Yuba Dredges."

Name _____ Title _____

Company _____

Street _____ City _____

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ELECTROMAGNETIC SURVEY UNITS (SE-100)

For locating base metal deposits which may not produce marked magnetic anomalies. Compact. Portable. $2995.

VERTICAL FORCE SURVEY MAGNETOMETER (A-2)

Designed for one-man operation. Faster coverage, lower labor cost. Sensitivity: 10 gammas or more per scale division. $1995.

VERTICAL FORCE RECON MAGNETOMETER (DI-M)

For delineating structures with abnormally high magnetic characteristics and ground checking magnetic maps. $610.

SELF-POTENTIAL (SP-S) & RESISTIVITY UNIT (SP-SR)

For primary gold and base metal exploration to reveal location of disseminated sulphides. Four electrodes. Self-potential only, $715. With resistivity attachments, $1210.

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Africa *(Continued)*

Macalder-Nyanza Mines Ltd. Output from the mine, which received a loan of £1.2-million from Colonial Development Corp., has been set at 2,500 tons Cu, 10,000 oz Au and 75,000 oz Ag per year. In June, a roast leach plant was expected to begin operation, producing cement copper. Leach plant is at Jinja, Uganda.

IN THE PHILIPPINES

While regular mining operations were suspended at the Atok-Big Wedge mine in the Baguio area in November 1953 because of high costs and lower values for the remaining ore reserves, a limited crew was retained to maintain the machinery and equipment in good condition and to keep underground workings accessible. However, in July 1955 milling was resumed on a 50-tpd basis and continued to date. Production during the period was valued at over 50,000 pesos. The company is planning to acquire base metal claims and is adding to its technical staff with this in view.

Gumaos Goldfields has an operating contract with Paracale Gumaus Consolidated Mining Co. under which the latter will mine and mill its ore on a sliding scale royalty basis. The company has recently made an agreement with Ferrun Exploration & Development Co. to operate and develop nickeliferrous ore on Homonhon Island.

Philippine Government has announced a $25-million steel project to be financed by a bond issue to establish steel smelting plants in five provinces all near sources of iron ore, coal and power. Pig iron from blast furnaces will be processed into steel sheets and structural products.

Hixbar Mining Co. has contracted for construction of a mill on Rapu-Rapu Island, Albay, with a capacity of 275 tpd. Construction will be completed by the end of the year. Mine has been under rehabilitation and development since the end of the war. In prewar days, Hixbar was a substantial producer of copper ore shipped to Japan.

Director Benjamin Gozon of the Philippine Bureau of Mines predicted that Philippine mineral production in 1956 will exceed $100-million in value, an increase of 30% over 1955.

Stockholders of Itogon Mining Co. have approved a merger of the corporation with Suyoc Consolidated and Palidan-Suyoc Level Tunnel Co. The consolidated company will be known as Itogon-Suyoc Mines Inc. These are all Marsman-controlled companies and had a notable gold output before the war.

Mindanao Mother Lode Mines has announced that its new copper property at Cabangan, Zambales went into operation in April. A first shipment of 1200 tons of concentrates was to leave for Japan in May.

Philippine Iron Mines, largest iron producer in P. I., has given its 3,000 workers a daily wage increase and a $25,000 credit to open a cooperative store, as well as a number of improvements in working conditions.

Surigao Consolidated has an interesting development bet on the Ancheta copper claims in Santa Cruz, Zambales. The claims were acquired under an operating agreement with the owners. A preliminary exploration program by inclined winzes was laid out. Crosscuts from the bottom of the winzes showed a vein averaging 3% copper. In both winzes considerable amounts of oxide ore appeared a short distance down, with primary sulphides at 50 ft. Surface trenching has traced the vein on the surface for 1600 ft. Winzes will be continued on the vein, and if these show continued good results, drilling will be done to test the orebody at greater depth.

Philippine Cabinet has been studying a bill to speed development of the nickel-iron deposits in the government's Surigao mineral reservation. It was presented by the Director of Mines and provides for an extension of the areas which can be acquired and developed by private interests.

Meanwhile, Samar Mining Co., which owns one of the largest nickel-bearing properties in the Philippines, has announced that it has received an offer from a large foreign mining company to help develop them. Elizalde and Co., which manages Samar Mining, indicates that ore on the property assays from 0.5 to 1.58% nickel content. The holdings are on Homonhon Island and other islands in the group off the east coast of Samar.

Annual Reports *(from p 126)*

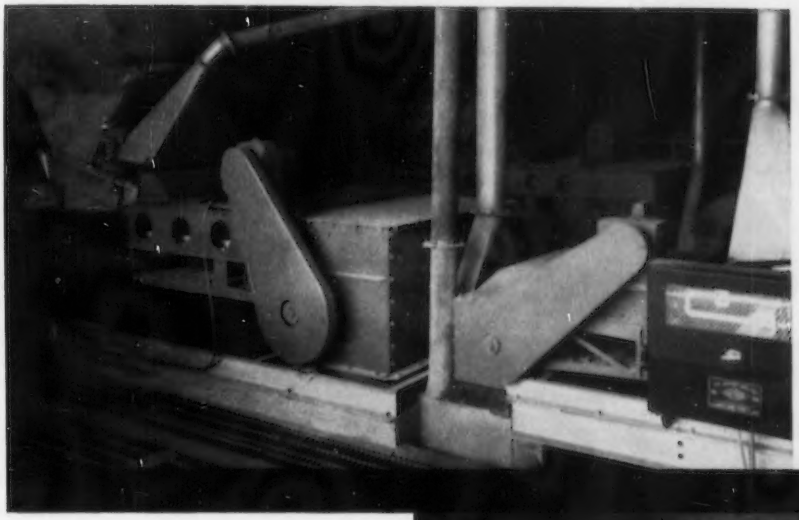
Rayrock, Northwest Territories, and claims near Kamloops, B. C.

Consolidated Sudbury Basin Mines, Ltd. reported drilling had indicated reserves in Vermillion and Errington at 13,189,356 tons, 1.14% Cu, plus Pb, Zn, Au and Ag. Laboratory testing in company lab and at Batelle continued.

Canadian Malartic Gold Mines, Ltd. had net profit in 1955 of $135,630, including Gold Act assistance. Ore reserves at year end were 1,490,000 tons, 0.114 oz gold, after milling 469,431 tons, 0.11 oz gold. Exploration drilling in 75-mile radius of the mine was uneventful. Further drilling is warranted, based on work at the Cadillac Township claim. Drilling was discontinued on claims between Granet and Marrias Townships when grade declined on strike and dip.

Sherritt Gordon Mines Ltd. spent $3,522,000 on improvements and additions to Lynn Lake and Fort Saskatchewan and an additional $190,000 on outside exploration. Net income was $7,049,000. At Lynn Lake drilling for the first time in five years added new tonnage to ore reserves. At year end reserves were 13,820,000 tons, 1.146% Ni and 0.587% Cu.

WAYTROLS® feed an inferno with ± 0.1% accuracy



A metal producer reports ± 0.1% accuracy in proportioning with a pair of Jeffrey WAYTROLS.

Close formulation of the mixture as provided by WAYTROLS is vital to quality production in an electric furnace.

Mix an ore with slagging and reducing agents in the proper proportions. Apply the 3100° heat of an electric arc under carefully controlled conditions. Draw off the molten metal. Basically, that's the electrothermic process so widely employed today.

"Proper proportions" is the keynote to success. Inaccurate proportioning may ruin the entire process. Jeffrey WAYTROLS (continuous weigh feeders) help avoid that hazard.

WAYTROLS take materials from overhead hoppers and feed them at predetermined quantities or rates; so many ounces, pounds or tons per hour. They do this within the accuracy of the weighing equipment itself and without dependence upon the attention and judgment of the operator.

Weighing, batching and proportioning systems are described in Catalog 841. For a copy, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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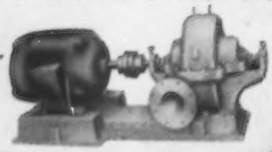
Capacities to 1,400 G.P.M.

Heads to 460 Ft.



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Capacities to 150 G.P.M. Heads to 500 Ft.

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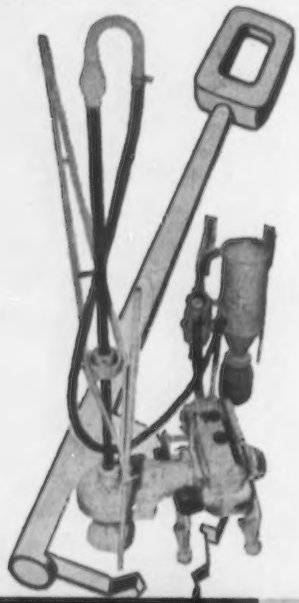

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DRILLS BY VACUUM
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Impossible to lose circulation. Adaptable to geophysical, shot hole, blast hole, rat hole or surface pipe drilling rigs. Drills to 2000 feet. Removes cuttings at rate of 1 to 36 tons per hour.

MIGHTY MIDGET PORTABLE DRILL

- Weighs 125 lbs.
- Drills by vacuum — no water needed. 100% recovery of cuttings.
- Impossible to lose circulation. Powered by McCulloch 9 H.P. engine.
- Ideal for exploration drilling.
- Anywhere there is a hole to be drilled the Mighty Midget will drill it.
- For further information write Houston Tool Co., Santa Susana, California.

A PRODUCT OF THE HOUSTON TOOL CO.

Annual Reports *(Continued)*

Nickel production at Fort Saskatchewan was 16,666,574 lb. Significant improvements on ammonia leach plant have been made.

Firm dropped Michipicoten iron ore leases.

Torbrit Silver Mines Ltd. made $414,639 after taxes based on 1,460,598 oz silver and over 5,000 tons lead. Net reserves at year end were 345,431 tons, 14.3 oz silver.

Geco Mines Ltd. said that 15,227,251 tons, 1.76% Cu, 3.48% Zn and 1.77 oz Ag had been blocked out to date. Mill and permanent headframe will be installed this year. Production is expected to start some time in mid-1957.

McIntyre Porcupine Mines Ltd. had net profit after taxes of $2,809,845. They milled 810,420 tons, 0.28 oz gold and had 2,530,291 tons, 0.318 oz gold reserves.

Belleterre Quebec Mines Ltd. saw their reserves decrease to 97,199 tons, 0.28 oz gold after milling 123,867 tons. Net profit was $232,255, including Gold Act assistance.

Mining Corp. of Canada, Ltd. reported net income of $3,866,062, based on income from Quemont Mining Corp., Hudson Bay Mining & Smelting Co., Normetal Mining Co., and Torbrit Silver Mines Ltd. shares. The corporation had an electromagnetic survey run over Chazel, Clermont, Desmeloizes and Perron Townships, Quebec and part of Ontario. Many anomalies were spotted, but most proved to be graphite and sulphide bodies of which no value has been determined.

Normetal Mining Corp. Ltd. said ore reserves at year-end were 2,675,100 tons, 2.4% Cu and 8.24% Zn. They milled 362,173 tons.

Quemont Mining Corp., Ltd. milled 842,807 tons and had 8,440,000 tons, 0.158 oz gold reserves at year-end. Net profit was $6,219,850.

American Leduc Petroleums Ltd. has seven mines on Colorado Plateau. They now mine about 3,000 tons per month. Gross revenue from these uranium holdings amounts to about $60,000 a month.

Grootvlei Proprietary Mines, Ltd. holds 6,624 claims in the Union of South Africa. Their net profit from gold mining was £1,411,888. In 1955, 2,322,000 tons, 4.34 dwt ore were milled. Reserves at year-end were 15,500,000 tons, 4.6 dwt gold.

Geduld Proprietary Mines, Ltd. had net profit during 1955 of £1,077,380, based on its own mining and holdings in other gold mines. Ore reserves at year-end were 1,500,000 tons, 3.6 dwt ore.

Banner Mining Co. in its first full year at Pima District mine had net income after taxes of $609,880. Mineral Hill grinding mill capacity was doubled to more than 900 tpd. New copper hori-

A FULLY AIR-CONTROLLED 1¼-YD. MACHINE

THE NEW LORAIN-56

1¼-YD. SHOVEL

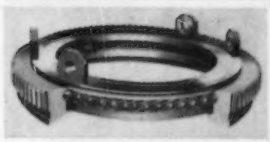
25-TON CRANE
(as fully convertible machine)

30-TON CRANE
(as heavy-duty lifting Crane on extra-wide crawlers)

ALL OF THESE FEATURES AND MANY MORE ARE STANDARD

2 LEVER "METERED" AIR OPERATION

Easier! Faster! Simpler! Uses only 2 levers to apply "Air-Ease" power to all turntable operations. A new concept in fingertip control. Retains full "feel" of machine.

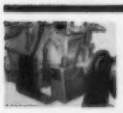


"SHEAR BALL" MOUNTING

No centerpin or nut, no rollers to wear. No adjustments! Provides smooth, rock-steady, "ball bearing" swing. Nothing else like it on any other make of shovel-crane.

SQUARE-TUBULAR-CHORD CRANE BOOM

Lighter! Longer! Stronger! New, patent-applied-for design gives greater strength, less weight. Permits increased lifting capacities and working with longer booms.

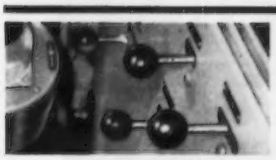


TORQUE CONVERTER

Gives the smoothest, most productive power take-off that can be had. Multiplies engine torque. Effectively absorbs digging shocks and strains. No-stall, "never-say-die" power hangs on—maximum work obtained from the diesel engine.

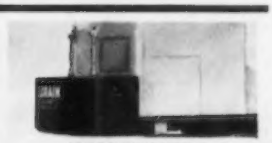
ANTI-FRICTION BEARINGS

Now, anti-friction bearings on hoist and swing drums and travel shaft provide the ultimate in performance . . . smoother, more efficient.



AIR CONTROL OF CRAWLER

Now — air does the work, controls travel, steering, tread lock, swing-travel jaw clutches. Far greater ease of operation. Adds greatly to production.



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New design makes it possible to detach counterweight easily for lower weight when transporting this new Lorain over the highway. Can be removed or installed in minutes.

Here's the newest 1¼-yd. shovel-crane, the Lorain-56 —and it has *all* the newest, most advanced features combined into one machine. 2-lever, metered air controls... "Shear Ball" mounting... torque converter... and many, many other *standard* features are included. Operators will like its simple, easy operation and freedom from adjustments. Owners will find the resulting higher production profitable. A few of these outstanding features are briefly described at the left. Get the *full* Lorain-56 story from your Thew-Lorain Distributor now!

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In excavating the marine channel on Galop Island in the St. Lawrence Seaway, millions of yards of heavy boulder-strewn glacial till are being moved under the toughest haul road conditions.

The Galop Island project is well on its way and as on other Seaway jobs, Firestone nylon tires is the answer because they are tougher tires. They cut big downtime losses, give more retreads and keep tire costs at a minimum.

Firestone nylon tires are built for severe service. The treads give maximum traction and they are extra tough to resist cutting. Double-thick sidewalls give added protection against cuts and snags.

Firestone's Safety-Tensioned *Gum-Dipped* nylon cord body gives greatest protection against impact breaks . . . flex breaks . . . heat failures . . . and water damage.

Let your Firestone Dealer or Store show you how Firestone nylon tires will cut downtime and increase the profits on your job.

A TIRE FOR EVERY ROAD, LOAD AND CONDITION OF SERVICE

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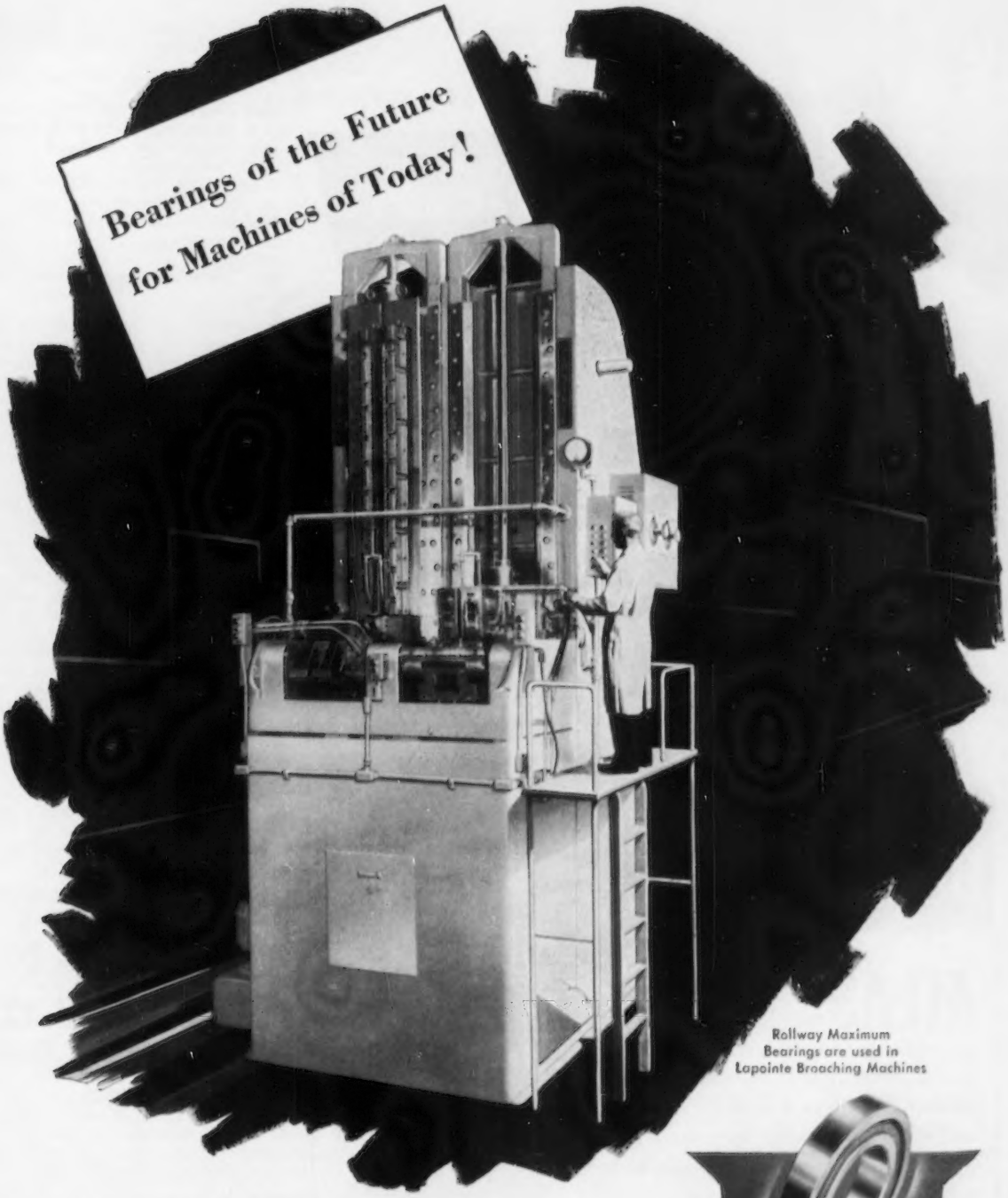

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Rollway roller bearings regularly offer performance capabilities for more than the needs of today. They are continuously anticipating the operating requirements of years ahead.

Wherever bearing precision and load values are important in your plant or products — for original equipment or replacement service — call on Rollway *bearings of the future*, to give you the utmost performance in your machines of today. Rollway Bearing Company, Inc., Syracuse 4, N. Y. Manufacturers of a complete line of radial and thrust cylindrical roller bearings.

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SCOOT-CRETE
Keeps Uranium Rolling
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Scoot-Crete Model "CD-3" Pay Load, 10,000 lbs. Turning Radius, 144".

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ATLAS builds storage battery locomotives to suit "actual" conditions of your operation . . . still using standard, field-proven parts. Ask for a quote on a "special" design and be surprised how easily and economically you can get a machine built to "suit" your needs.

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Annual Report (*Continued*)

zons have been located in Pima district.

Miami Copper Co. reported that 96,674,056 lb copper were taken from company mines. Copper Cities completed first full year of production.

Copper Cities reserves are 29.5-million tons, plus considerable low-grade.

Mineable reserves (sulphide) at Miami were 16-million tons. Some 3.5-million tons oxide ore will be leached in place. Castle Dome continued to leach with mine water.

Madsen Red Lake Gold Mines Ltd. had 850,560 tons, 0.3 oz gold at year end. Drilling continued to increase reserves ahead of milling. Net profit for year was $882,183, with no Gold Act assistance. Operating costs were cut by 30c a ton hrough increased plant capacity, reduction in exploration drilling and a further reduction in milling costs.

Pacific Tin Cons. Corp. operated three dredges during the year: one at Ampang, one at Kota Bharu and another at Kampar. Four dredges now in operation. Kota Bharu reached end of economic reserves and has discontinued mining. Tin reserves now stand at 24-million lb metal.

Feldspar Corp. liquidated four companies within three months of their purchase and operated four others. They have plants at Spruce Pine and Burnville in N. C.; Erwin, Tenn. and Monticello, Ga. Net income was $342,992.

Opemiska Copper Mines Ltd. completed second year with net profit of $2,382,861. Ore reserves were 2,244,420 tons, 4% Cu. This is 798,850 tons over previous estimate, after milling 162,000 tons. Mill now treats over 600 tpd, hopes to reach 850 tpd design figure in 1956.

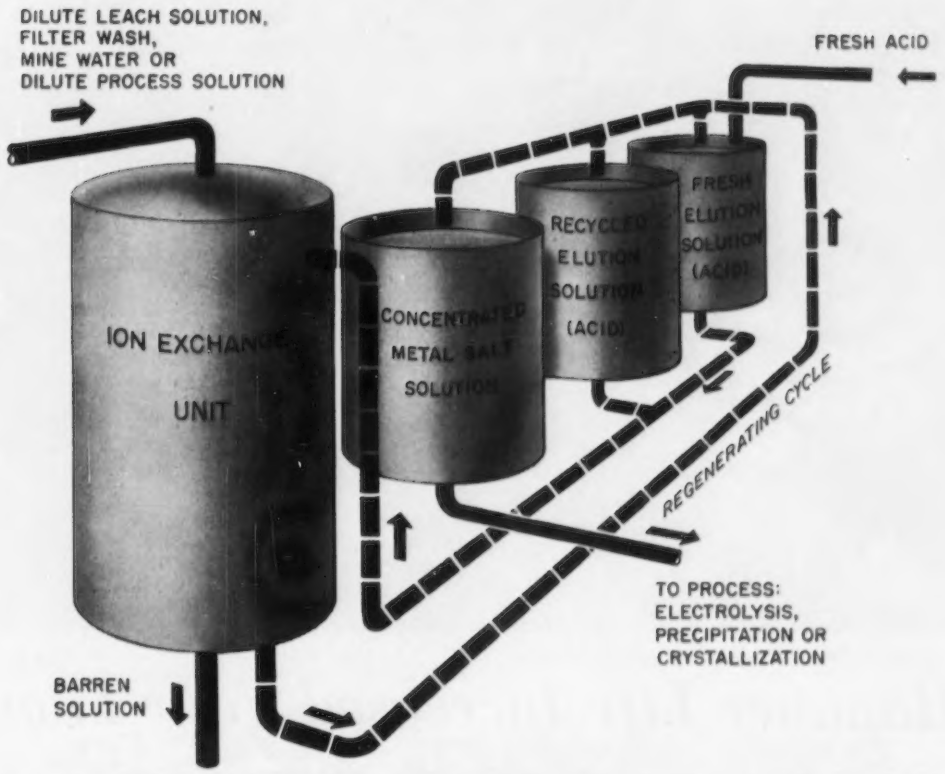
Camp Bird Ltd. reported that it intends to reopen the Camp Bird mine, Colo.

Frobisher Ltd. reported that its Connemara division had 296,790 tons 0.2 oz gold. Only two years reserves at present capacity (435 tpd). Connemara is running at low rate. Frog and Just-in-time are being developed.

Seal Lake Concession in Labrador conducted two airborne surveys for copper—nothing exciting found. Drilling will start on several anomalies. Biggest news was find of low-grade radioactivity (pitchblende) in the area. They have asked for larger concession to cover this find.

Union Corp. owns or hold interest in the following mines: East Geduld (reserves 10.7-million tons, 5.8 dwt gold), Geduld Proprietary (reserves 1.5-million tons, 3.6 dwt), Grootvlei Proprietary (reserves 15.5-million tons, 4.5 dwt), Marievale Cons. (reserves 4.5-million tons, 5.4 dwt), St. Helena Gold Mines (reserves 3-million tons, 6 dwt), Van Dyk Cons. (reserves 800,000 tons, 3.8 dwt), Winkehaak (sinking shafts), Withok Proprietary Co. (mineral claims in Transvaal), Stilfontein Gold Mining Co. (reserves 3.5-million tons, 8.7 dwt), Western Holdings (reserves 2,273,000 tons, 10.8 dwt), San Francisco Mines of Mexico (reserves 5-million tons, 0.7 gm gold) and Chrome Mines of South Africa.

METAL CONCENTRATION BY ION EXCHANGE



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Ion Exchange gives Better Yields

• Ion exchange increases yields, simplifies flow sheets and cuts labor, supervision and chemical costs when used with other hydrometallurgical processes such as Leaching, Clarification, Filtration, Purification, Precipitation and Electrolysis.

The simplified flow diagram shown above illustrates the main principles of ion exchange in concentrating metals from leach liquors, filter washes, other dilute process solutions or mine waters:

As the feed solution or mine water passes through the ion exchange unit, the metal values are concentrated on the ion exchange resin, generally in preference to other ions present, leaving the solution or mine water metal-free. When the metal-attracting property of the resin is exhausted, an appropriate elution solution, for example an acid, is passed through the resin to pick up the metal. In most cases, the elution solution also acts as regenerant to restore the metal-attracting capacity of the resin . . . as shown on the diagram. Recycling the elution solution provides high concentrations . . . often several thousand times as concentrated as the original feed solution.

Ion Exchange methods apply to these metals:

Base Metals	Minor Metals	Precious Metals
Copper	Cobalt	Gold
Zinc	Tungsten	Silver
Lead	Molybdenum	Platinum
Tin	Vanadium	**Rare Earths**
Aluminum	**Decorative Metals**	Lanthanide Group
	Nickel	Actinide Group
	Chromium	Uranium

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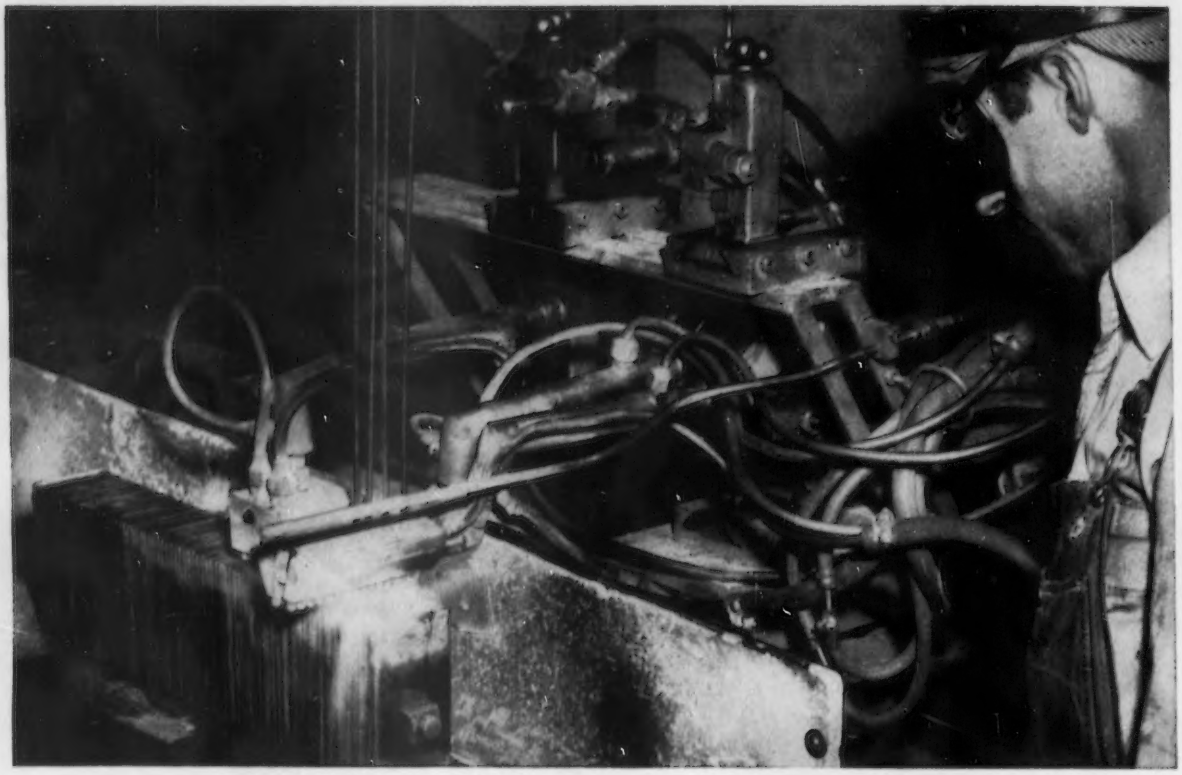

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Hard-facing with HAYSTELLITE tube rod has increased the life of hammers used in a heavy duty grinder by four times. The hammers rotate at from 3000 to 3600 revolutions per minute while pulverizing limestone, mica and other severe abrasives. They are hard-faced mechanically on a model 800 straight-line machine. Seventy hammers are processed at a time, and 1000 hammers are hard-faced in a normal working day.

HAYSTELLITE rod, the hard-facing material used on the hammers, forms an extremely hard surface that has good resistance to impact. It produces a deposit of sharp, irregularly shaped particles of cast tungsten carbide evenly distributed in a matrix of tough steel. The tungsten carbide particles resist abrasion, and the steel matrix cushions the effects of sudden shock.

There are 18 HAYNES hard-facing alloys . . . a wide selection that guarantees you the right rod at the right price for every wear problem. These hard-facing rods have achieved excellent results in the earth moving and quarrying industries when used to protect such parts as cable drums, hammers, crusher rolls, bucket teeth, and conveying screws. They can be the economical answer to your wear problems too.

Ask your local HAYNES STELLITE dealer for a copy of "HAYNES Hard-Facing Manual." It contains descriptive information and application data on the complete line of HAYNES hard-facing alloys. If you don't know the location of your local dealer, write to Haynes Stellite Company, a Division of Union Carbide and Carbon Corporation, Kokomo, Indiana.

See... Your local Haynes Stellite Dealer

or

Write... to Haynes Stellite Company

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Shook and Fletcher Supply Company of Birmingham move better than 8,000 yards of overburden every 24 hours with their 4500 dragline equipped with a 4 yd. bucket and 140′ boom. The big Manitowoc takes plenty of punishment working two 10-hour shifts a day. Company is stripping 40′ to 100′ of overburden, uncovering iron ore seams.

reach more ore

...with a Manitowoc 4500!

LONG RANGE, BIG CAPACITY DRAGLINE has exceptional stability on any terrain — easily handles 4-6 yd. buckets on 120′-140′ boom. Reaches way out for full capacity loads with complete safety and low ground bearing pressures.

CLEAN, SIMPLE DESIGN of 4500 applies maximum power to the load. Just 15 gears—only working gears turn. Every gear not needed saves up to 10 horsepower!

UNRESTRICTED TRAVEL EASE with no cumbersome trailing electrical cables. Can be shipped and assembled at another job site in days rather than weeks.

SPECIALLY DESIGNED FOR MINING to produce greater yardage. Tough enough for the roughest working conditions — yet mobile and convertible as a small excavator. Special hi-lift shovel booms for long, high reach. Smooth torque converter power balances power to the load for greatest efficiency.

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SHOVELS 1 - 5½ YD. Speed Crane CRANES 20-100 TON

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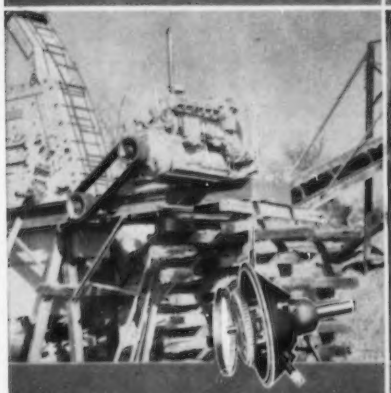

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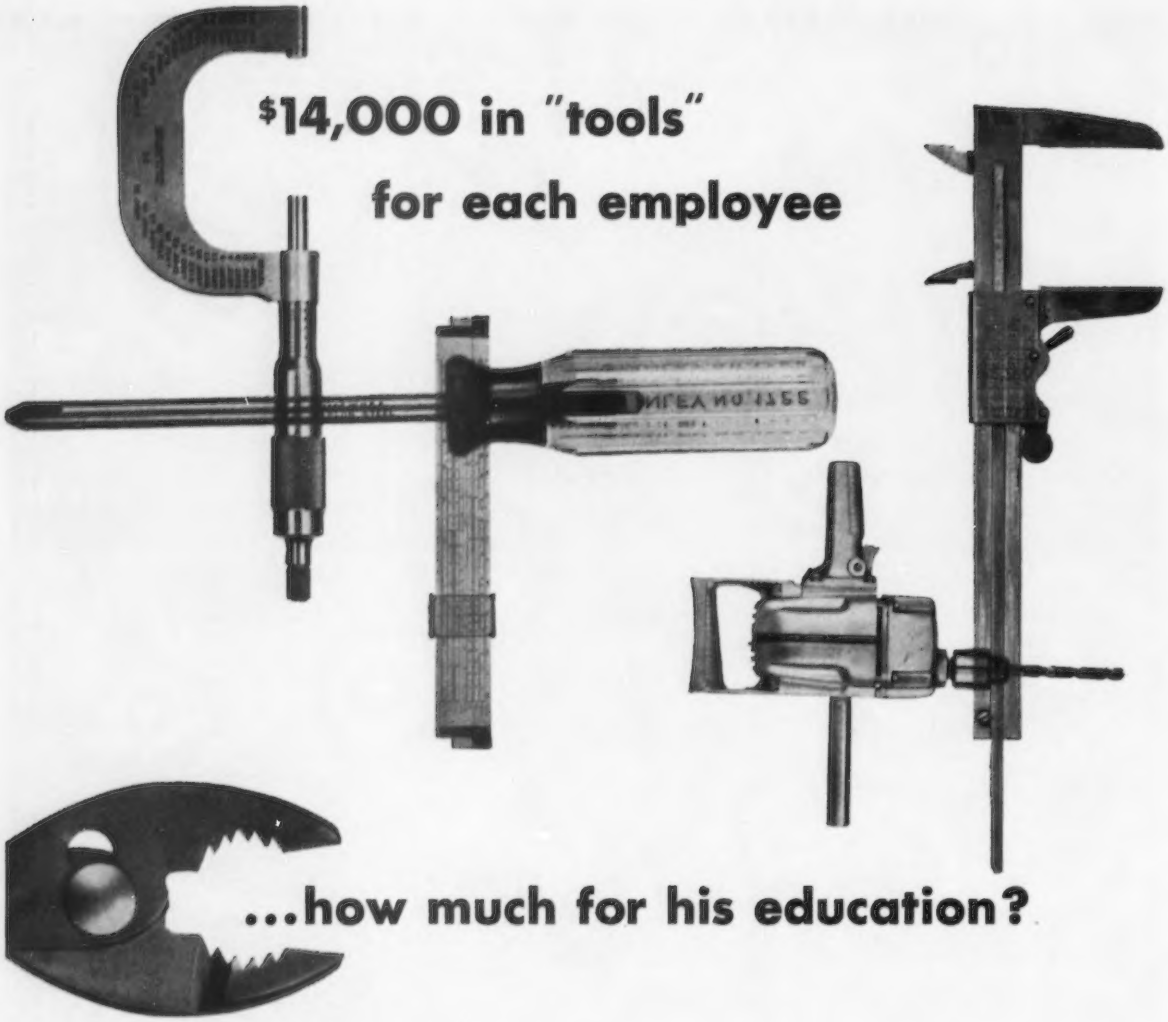

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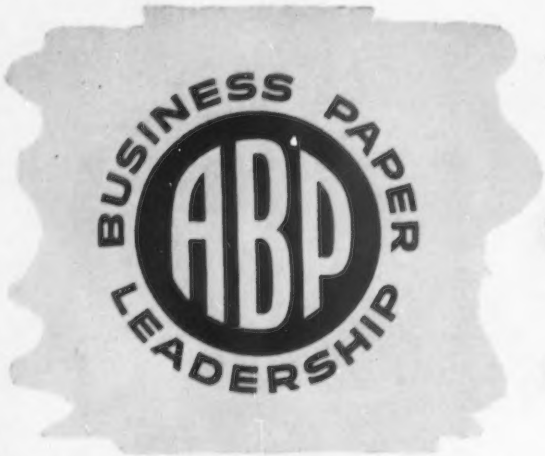

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The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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For prompt and complete information, address resume of education and experience to Employment Supervisor, Dept. J-102,

NATIONAL LEAD COMPANY
CONTRACT OF OHIO OPERATOR
Feroald Atomic Energy Commission Project
P.O. BOX 158 MT. HEALTHY STA. CINCINNATI 31, OHIO

ENGINEERS — MECHANICAL OR MINING

Why not work in the congenial atmosphere of a moderately sized, multi-plant industry where your engineering ability will have considerable diversification rather than get buried in one of the giants of industry?

This old-line, well-established, progressive company has immediate need for mining and mechanical engineers.

GENERAL REQUIREMENTS ARE:

Degree (or equivalent in experience) from recognized college or university.

Two to five years' experience in your field. (Quarrying and/or Rock products preferred).

Age to 35.

Ability to get along with people.

Some travel associated (we have five plants in the North Eastern part of the country).

Your base of operations is near Chicago.

Our compensation and extra benefits are abreast of current National surveys.

Send complete resume of formal education and experience background.

P-1566 Engineering & Mining Journal
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METALLURGICAL ENGINEER, age 46, broad experience in mill operation up to 10,000 tons per day, large and small mill design and detailed laboratory investigation. Operating experience in both metallic and non-metallic fields. Interested in top level management or supervision in the field of Ore Beneficiation.

PW 1770 Engineering & Mining Journal
520 N. Michigan Ave., Chicago 11, Ill.

Mining Engineer, 41. Successful record administration, operations and exploration non-ferrous metals, nonmetallics. Mine plant design and construction. Desire new connection with progressive organization. Please reply to

PW 1769 Engineering & Mining Journal
330 West 42nd Street, New York 36, N.Y.

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Nation wide recruitment through 54 offices of the National Ass'n of Personnel Consultants at no charge to the employer. The Pacific Northwest's leading employment firm.

ACME PERSONNEL SERVICE
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EMPLOYMENT ADS
ON OPPOSITE PAGE

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Junior geologist and junior mining engineer for lead-zinc mine in Northern Mexico. Knowledge of Spanish helpful but not essential. Excellent climate and living conditions. Please give full details. P-1419, Engineering & Mining Journal.

Smelter Superintendent — Required for 5,500 K.V.A. electric copper smelter near Jinja Township, Uganda, British East Africa. Applicants should be fully experienced in copper smelter operation consisting of electric furnace, converters, etc. Three year contract offered with married accommodation, passages and allowances. Good working and climatic conditions. Top salary for successful candidate. Apply with fullest details as to experience, references, personal data, etc. to General Manager, Kilembe Mines Limited, P.O. Kilembe, Uganda, British East Africa.

Progressive nonmetallic plant in Northern New York has opening for young aggressive engineer. Prefer applicant with mineral benefication background and experience. Exceptional opportunity for advancement. P 1774, Engineering & Mining Journal.

Research Metallurgist: Required for Island of Cyprus. Metallurgical engineer or mining engineer with good training and experience in metallurgy to conduct tests for improving practice in 100 ton per hour mill floating heavy copper sulphide ores and also to conduct tests on grades and mixtures of varying copper content. Aptitude and interest primarily research. Age to 45 years. Three year contract. Salary open. Submit complete record and list of references with first reply. Cyprus Mines Corporation, 523 West Sixth Street, Los Angeles 14, California.

POSITIONS WANTED

Graduate Mining Engineer. 14 years in the mineral industries. Educated and experienced in management, geology, mining and metallurgy. Resume on request. PW 1897, Engineering & Mining Journal.

Engineer, 1956 graduate, Mackay School of Mines BS in mining. Veteran, 29, married. Experienced in mechanical maintenance, surveying, assaying. Knowledge Spanish, U.S. or foreign. Available 9-1-56. PW 1786, Engineering & Mining Jrl.

Mine Manager-Engineer: Registered Mining Engineer, 35, 12 years experience engineering, supervision, management in open pit and underground mining, milling and mine plant construction desires permanent responsible position mining or construction, Western U.S. or Foreign. PW 179", Eng. & Mining Journal.

Exploration manager, graduate geologist, 18 years experience mineral development, now employed in uranium exploration, desires Western exploration or mine mngt. contract. PW 1894, Eng. & Min. Jrl., 68 Post St., San Francisco, Calif.

Graduate Maintenance Engineer and Master Mechanic. Married, Spanish speaking, age 39, over 12 years of employment in important U.S. Firms most in South America. Excellent background in maintenance of equipment in mine, mill arial tramway, repair shop, powerstation, construction work. At present general maintenance and plant supervision. Desire foreign position with considerable responsibility. Available September or December 1956. PW 1861, Engineering & Mining Journal.

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(Classified Advertising)

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Leading equipment manufacturer needs Field Service engineers to supervise erection and maintenance of electric shovels. Electrical engineering degree desirable but not necessary if applicant has suitable background and experience. 30-40 age preferred. Write, giving full particulars to

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HARNISCHFEGER CORPORATION
4400 W. NATIONAL AVE.
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Graduate Mining, Metallurgical, Chemical or Mechanical Engineer, preferably 25 to 35 years old, wanted by medium size progressive heavy machinery manufacturing company located in Southeastern Pennsylvania. To assist in design and preparing for market of various lines of equipment used in mineral dressing, heavy chemical, cement and rock products industries. Must have had engineering and field experience, and be willing to work on drafting board, travel and do field service. Opportunity also exists for a properly qualified individual, eventually to become a sales engineer. Salary open.

P-7533 Engineering & Mining Journal
330 W. 42nd St., New York 36, N. Y.

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Unusual opportunity for engineer with base metal smelter design experience for permanent staff position with major engineering and construction firm. Copper, nickel and zinc experience desirable. Please contact

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If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but, more important, it will identify you as one of the men the advertiser wants to reach with this message . . . and help to make possible enlarged future service to you as a reader.

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A real bargain; owner needs money. No risk; investigate before investing. Write immediately to

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10" x 17" 10 oz Duck
Only $25.00 per hundred
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2036 Market Street, Denver 5, Colo.

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3—10' McCully Gyratory Crushers
3—Traylor No. 412 Type TZ Gyratory Crushers
2—Traylor 6' Gyratory Crushers
1—New RCA Metal Detector 10" x 36" aperture
6—Used single deck Robins Gyrex Screens with bases
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1—Used Cameron pump, size 10", 2400 G.P.M., 125' head, 1150 R.P.M., Left Hand, Serial No. 57537
1—Used Cameron pump, size 10", 2400 R.P.M., 125' head, 1150 R.P.M., Right Hand, Serial No. 57535
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4—Allis Chalmers Gates "D" Crushers, Size 6
1—Traylor Rolls Crusher — 30" x 72"
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*1—Allis Chalmers Compeb Mill
1—Gill Horizontal Bit Dresser
1—1-Ton Cummer Black Top Plant
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15,000 feet, 4-INCH O. D.
Black Iron Pipe
clean, plain ends, 7#/ft.
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2500 TON – 400 TON – 250 TON

FIRST TIME OFFERED—IMMEDIATE DELIVERY

PLANT NO. 1- 2500 Ton Flotation Mill Stibnite, Idaho

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2—4' x 4' steel tank Reagent agitators with 5 HP Motors.
4—7' x 8' Galigher Wood Reagent Agitators with wood tanks and 15 HP Motors.

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2—6' x 25' Dorr Duplex Rake type, w/motors.
1—72" x 23' Wemco Spiral, double pitch, Model SCM, with gearmotors.
2—60" x 20'-9" Wemco Spiral, Model SCM, with Gearmotors.
1—60" x 23'-3" Wemco Spiral, 7½ HP Gearmotor.
1—Krebs Centricione, Size A-10 with 7½ HP Motor.

CONDITIONERS
6—5' x 5' Galigher with steel tanks, 5 HP Motors.

CONVEYORS, BELT
1—36" belt x 584' centers, mtd on steel frame, 7-ply belt with belt tighteners and powered by 150 HP West Gearmotor. Absolutely excellent condition.
1—36" belt x 523' centers, on steel frame, 8-ply belt.
1—36" belt x 150' centers, on steel frame, 8-ply belt, powered by 30 HP Motor & Am. Speed Reducer.
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1—5½' Symons Shorthead Cone, Ser#5178, with 150 HP Motor and Controls. Excellent.

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4—24" x 48" centers, Belt type, with wheels on steel frames for movement under several bins.

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3—Bucket type Galigher, double feed.
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2—Geary, dry feed, motorized.

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1—4½' x 8' Oliver Drum type with all accessories and drives.
1—4½' x 6' Oliver, drum type complete.
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20—Galigher Agitair, 2 cells per unit, size 48" x 48", dual drives from 10 HP Motors.
5—2-cell Pan American, 48" x 48", dual drives, 5 HP Motors.
2—4-cell #30 Denver Sub A, 48" x 48", rubber parts, steel tanks, motorized.

MAGNETS
1—36" Dings Rectangular Suspended type, with MG set.
1—Automatic Detector, shuts off belt conveyor at presence of tramp iron.

MILLS, BALL AND ROD
1—9'-6" x 12' Marcy Rod Mill, 1944 model, herringbone gears, 95% new liners, includes rod charge, 450 HP Synchronous Motor and controls. Excellent.
1—8' x 6' Marcy Ball Mill, herringbone gears, 250 HP G.E. Motor and controls.
3—8' x 48" Hardinge Conical Ball Mills, with liners, 225 HP Motors.
1—8' x 36" Hardinge Conical Ball Mill, 150 HP Motor.
1—5' x 8' Joshua Hendy Ball, with motor.

PUMPS, SAND AND ACID
6—6" Allen-Sherman-Hoff Hydroseal, 15-20 HP Motors.
6—2" Wilfley Sand Pumps, 5 HP Motors.
7—4" Wemco Sand Pumps, 10 HP Motors.
1—3" Wemco Sand, 7½ HP Motor.
2—2" Wilfley Reagent Solution Pumps.
2—1" Wilfley Acid, 3 HP Motors.

SCREEN
1—5' x 10' Tyler Ty-rock, 2-deck, 7½ HP Motor.

THICKENERS
1—24' x 8' Hardinge Spiral Rake, steel tank, with diaphragm pump and motor.
2—20' x 8' Hardinge Spiral Rake, steel tanks.
2—15' x 8' Wemco, steel tanks, angle rakes.
1—11' x 10' Hardinge spiral Rake with steel tank.

OVERHEAD CRANES
1—15-ton Shaw-Box, 34' span, 25' lift.
1—15-ton Shaw Box, 25' span, 25' lift.
2—10-ton Shaw Box, 35' span.

PLANT NO. 2- 250 Ton Flotation Mill Ouray, Colorado

BALANCES, LAB.
1—Ainsworth Pulp, Mahogany Case.
1—Ainsworth Analytical.

BALL MILLS
1—5' x 5' Allis Chalmers, new liners, new main gear, with 75 HP, 440 volt Motor, controls and drive.
1—6' x 8' Allis Chalmers, herringbone gears, excellent condition with 75% good liners, 150 HP Motor controls and drive.
1—5' x 4' Marcy, like new condition, w/40 HP motor.
1—6' x 4½' Marcy, New grate liners, 100 HP Synchronous Motor.

BLOWERS
2—Spencer Turbo-Compressors, 240 cfm, 1 HP.

BOILER
1—75 HP Erie City RT Type.

CLASSIFIERS
1—4½' x 16' Dorr duplex Rake.

COMPRESSOR
1—GE Centrifugal-2000 cfm at 1.5 lbs w/18 HP motor.

CONVEYORS, BELT
1—24" x 98' centers, modern, 5 HP electric drive.
1—18" x 15' centers, 1½ HP Gear Motor, excellent.
1—18" x 76' centers, excellent, 5 HP Gearmotor.
2—16" x 22' centers, steel frame, 1 HP Gearmotor.
1—12" x 15' centers, wood frame, 1 HP Motor.
1—16" x 26' centers, wood frame, 1 HP Gearmotor.

CRUSHERS
1—10 x 24 Jaw, Denver Type J, Roller Bearing, 40 HP Motor.
1—5" x 6", Denver sample w/3 HP Motor.
1—Lab Sample Grinder, McFarland-Eggers w/5 HP Motor.
1—4" x 6" Jaw, Laboratory, Massco, w/3 HP Motor.

FEEDERS, ORE
1—36" x 50" Denver Travelling Belt Type w/3 HP Gear Motor.
1—16" x 36" Denver, Travelling type, less motor.

FEEDERS, REAGENT
3—#2 Denver Cone Type, dry.
2—#12 Denver Wet Type, one compartment.

FLOTATION MACHINES
2—8 cell #18 Denver Sub A, rubber part, wood tanks.
1—#250 Denver Unit cell, rubber wearing parts.

FURNACE, MUFFLE
1—DFC Assay Furnace, Single Muffle, oil fired.

JIGS
1—12 x 18 Duplex Denver, w/1½ HP Motor.

MAGNET
1—Dings, Suspended type with rectifier.

PULVERIZERS, LABORATORY
2—Braun UA, with 1½ HP motors.

PUMPS
1—2" Denver Vertical Sand pump, w/3 HP Motor.
3—1¼ Denver Diaphragm Pumps.

SAMPLE CUTTERS
1—Denver chain and bucket type, 10½' center, 1/35 cwt.
1—Denver Snyder, 3' dia., 10% sample, ½ HP Gearmotor.

SAMPLE DRYERS
1—24" x 45" x 25", w/110 Volt elements.
1—36" x 36" x 24" Denver, 110 volt AC.

SCALES, TRUCK
1—10 ton Fairbanks Morse 8½' x 14'.

SIEVE SHAKER, LABORATORY
1—Denver, Suspended type, motorized.
46—8" Tyler Sieves, All Mesh Sizes.

TRANSFORMERS
3—150 KVA West. 11,000—460 volt, 60 cycle, outdoor type.
2—150 KVA Allis Chalmers, 11,000—460 volt.
1—50 KVA GE, 11,000—240/480 volts.

WEIGHTOMETER
1—Fairbanks Morse Conveyor Scale, for 18" belt width.

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PLANT NO. 3- 400 Ton Flotation Mill Los Lunas, New Mexico

RAGGING MACHINE
1—St. Regis, 2-spout, type 107-FC w/10 HP Motor and 1½ HP Gearmotor on bin agitator.

BOILER
1—Kewanee 125 HP, high pressure, gas fired 500 psi gauge, coded, excellent.

CABLE, ELECTRIC
1,020 ft No. 1, 3-conductor, Simplex Tirex, 600 volt insulation.

CLASSIFIER
1—9' Denver centrifugal lab type w/¼ HP Motor and drive.
1—45" x 17'3" Akins Spiral, w/3 HP Gearmotor.
1—45" x 18'3" Akins Spiral, w/3 HP Gearmotor.

COMPRESSOR
1—Garage type, Approx. 3 cfm, 200 lbs.

CONVEYOR, BELT
1—16" x 18' Belt, wood frame, takeups, complete, w/3 HP Motor.
1—16" x 28'7" centers, wood frame, spur gear drive, 2 HP Motor.
1—16" x 31'6" centers, wood frame, chain drive, ¾ HP Gear Motor.
1—24" x 40' centers, wood frame, w/3 HP Synchrogear Motor.

CONVEYOR, SCREW
1—6" x 54' w/gearmotor drive.
1—9" x 21'9" Denver, complete with gear motor.
1—9" x 24' Denver, with drive and gearmotor.

CRUSHERS
1—9 x 36 Cedar Rapids Jaw, Short frame.
2—10" x 20" Pacific, Type KH, One Unit powered with 15 HP motor, other with 20 HP motor, both excellent.

DRYER, ROTARY
1—54" dia. x 30' long Denver Equipment Co., w/5 HP Gearmotor and drive, gas fired, excellent.
1—5' dia. x 35' Ruggles-Cole, gas fired, w/7½ HP Pacific Gearmotor.

ELEVATORS, BUCKET
1—34' centers, vertical, belt type, 8" x 5" buckets, w/3 HP motor.
2—50' centers, Denver chain type, 6" x 4" buckets, 5 HP motor and drive.

FEEDERS, BELT ORE
1—16" x 31'6" centers, steel frame, 1 HP motor and Reeves variable speed drive.
2—16" x 316" centers, steel frame, 1 HP Pacific gearmotor and chain drive.
1—18" x 30" centers, steel frame with hopper, gearmotor and varispeed drive.
1—24" x 18" centers, Denver Equip. Co. steel frame, 1 HP motor and Reeves Vari drive.

FEEDERS, DRY REAGENT
2—Denver cone type No. 12, motorized.

FEEDERS, WET REAGENT
1—Denver simplex No. 12, motorized.
4—Denver Duplex 12", w/speed reducers and motor drives.
2—Clarkson Model E-2, 2 compartment w/speed reducer and motor.

FILTER, DISC
1—Denver 4', 2-disc, complete with all vacuum equip. and etc. All brand new.

FILTERS, DRUM
2—6' dia. x 4' face, Denver Equip. Co. fluorspar type, w/oscillating agitators and new stainless steel 60 mesh filter cloths, both complete and excellent.

FILTERS, PRESS
1—Denver Lab. 8" x 12".

FLOTATION MACHINES
1—2-cell Denver Sub-A No. 24, Steel tank, rubber wearing parts, practically new.
1—6-cell Denver Sub-A No. 24, Steel tanks, rubber wearing parts, Excellent.
2—8-cell Denver Sub-A No. 18 Sp. steel tanks, rubber wearing parts. Very good.

JIG
1—Denver Duplex, size 16" x 24", right hand, including Denver Dowsett discharge valves and 1½ motor, Brand new.

PUMPS, CENTRIFUGAL
1—LaBour, type MPL, with flex coupled 30 HP Motor.
1—Worthington 2½" high head w/7½ HP motor.

PUMP, DIAPHRAGM
1—Denver 6" Simplex adjustable stroke, with 3 HP Gearmotor.
1—Denver 4" duplex, adjustable stroke, with 3 HP Gearmotor.
1—Denver 2" Adjustable stroke, with 1 HP Pacific Gear Motor.
1—Denver 2" Adjustable stroke, simplex, Brand new less the motor.

PUMPS, SAND
1—2" Denver SRL rubber-lined driven by 1½ HP West. Motor.
1—2" Denver SRL, rubber-lined, w/overhead base, motor and drive.
1—3" Wilfley, iron wearing parts, Model C, with 10 HP motor and drive.
1—3" Denver SRL, rubber lined, with 10 HP motor and drive.
4—3" Denver SRL, rubber-lined, with 3 HP motors and drives.

PUMPS, SUMP
1—Mill sump pump, with 3 HP motor and drive.

PUMP, VACUUM
1—Worthington, Size 14" x 5" with 15 HP Motor, 354 cfm displacement. Single cylinder.
1—IR Type ER-1, 14" x 5", 354 cfm Displacement with 15 HP motor.

SAMPLERS, AUTOMATIC
4—Denver, with wet cast iron cutters, 110 volt.

SCALE
1—Denver pulp density, 1-liter container.

SCREEN, VIBRATING
1—2' x 6' Denver Dillon, double-deck, Suspension mounted, 2 HP motor.

TANK
1—150,000 Gal. bolted steel, 30' diameter x 24' high, open top.
1—11'8" Dia. by 12' high Storage tanks, conical bottom, mounted on four steel support legs.
1—11'8" dia. by 17'9" high Storage, with conical bottom, Mounted on steel column supports.

THICKENER
1—8' x 6' Denver Spiral Rake, lowhead mechanism with ¾ HP motor and drive, Brand new, Steel tank.
1—12' x 8' Dorr Type, with steel tank and lowhead mechanism which is excellent.
1—21'6" x 8' Deep Denver Spiral Rake, Bolted steel tank, 1½ HP Motor, rake lifting device and electric alarm overload warning system, excellent.

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CRUSHERS
1—2'-4" Traylor Reduction, Model TY.
1—24" x 12" Traylor Rolls, Type A.
1—6" x 12" Wheeling Jaw.
1—12" x 24" Wheeling Jaw.
1—28" x 36" Traylor Jaw.
1—MASSCO Gy-roll Lab Sample Grinder.

BUCKET ELEVATORS, vertical
1—40' Hack Engr., 3" x 4" buckets, belt type, steel casing, 1½ HP gearmotor, used only one month. Like new.
2—18'8" centers, 4" x 6" buckets, steel casings, 2 HP Gearmotor drives.

FILTERS
1—6' 4-leaf Eimco.
1—6' 3-leaf Eimco.
1—6' 2-leaf Eimco.
1—4' 6-leaf Eimco.
1—4' 4-leaf Eimco.
1—4' 2-leaf Eimco.
2—3' x 4' Oliver Drum units.

HOISTS, SLUSHER
2—S-211 Joy Electric Slushers, 1250 lbs pull.
1—FF-211 Joy Electric, 2000 lbs pull, 10 HP.
6—AAF-212 Sullivan 15 HP, electric 2500 lbs pull.
1—A-211 Sullivan 15 HP, electric 2475 lbs pull.
4—FF-211 Joy Air Slushers, 15 HP capacity (like new).

LOCOMOTIVES
2—1½ ton Atlas Battery, 24" ga, with new Exide MVM-15 Batteries.
1—4-ton Mancha Titan X, 24" gauge, with new Exide 48-TLM-17 Batteries.
2—3½ ton Mancha Titan BX, 18" guage.
1—3½ ton Mancha Titan AX, 36-42 gauge.

BALL AND ROD MILLS
1—4½ x 4 Marcy, excellent.
2—4' x 8' Kennedy Van Saun, like new.
1—5' x 10' Marcy Ball or Rod Mill.
1—5' x 10' Stearns Roger Rod Mill.

MUCKING MACHINES
4—Eimco 12-B, 18-24 gauge, rebuilt.
1—Eimco 105, Tractor Mounted.
4—GD-9 Gardner Denver, 18" gauge.

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200 Ft.	12"	8	36 Oz.	1/16"	1/32"	$3.80
92 Ft.	14"	8	36 Oz.	1/16"	1/32"	4.35
300 Ft.	16"	8	36 Oz.	1/16"	1/32"	4.85
280 Ft.	20"	6	32 Oz.	1/16"	1/16"	5.35
180 Ft.	30"	8	36 Oz.	1/8"	3/32"	9.62
937 Ft.	30"	Steel Cable Belting		1/4"	3/16"	10.00

58-3/16" Steel Cables and 3 Ply 48 Oz. Duck

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2—30" x 54", 3" x 8', 4' x 9', 4' x 11', 4' x 14', 5' x 10', 5' x 14'
HARDINGE CONICAL BALL MILLS
6' x 14", 6' x 22", 6' x 36", 7' x 22", 7' x 36" 8' x 18", 8' x 36"
BALL MILLS
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12—Type ES Kraut Cells
1—#500 and — #750 Denver Unit Cells
2—#30 (56" x 56") Denver
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3' x 6', 8' x 10', 12' x 14', 11'6" x 18' Oliver
12' x 10', 2 — 14' x 18' Dorrco Drum
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1—3' x 24' x 12' & 1—4'6" x 26' x 16' Wemco Bowl. 5' x 30' x 26', 16' x 24' x 28' & 3' x 24'10" x 10' Dorr Turret Bowl
8' x 38', 14' x 30' & 12' x 31'6" Dorr Rake
4' x 22', 48" x 27' — 3 Wemco Densifier
36" x 25' Eagle Screw
THICKENERS
Wemco 10' x 8', 14' x 12', 20' x 12'
Dorr 14', 16', 20', 24', 26', 36', 80' & 100'
30 IN. BELT CONVEYORS
1—30 x 140', 1—30 x 240', 1—30 x 360'
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1—G.E. 25 Ton, Like New.
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5' x 60', 6' x 28', 8' x 80', 9' x 125'

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Allis Chalmers Ball Mill, 6' D x 16' L.
Rotary Dryers: 3' D x 24'; 4'6" D x 40'.
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2—7 ton General Electric, 36" gauge, permissible
1—7 ton Atlas, 36"-48" gauge
2—8 ton General Electric 36" gauge
2—8 ton Goodman, 36" gauge
3—8 ton Ironton, 24"-48" gauge
4—10 ton Atlas, 36" gauge

TROLLEY LOCOMOTIVES
1—4½ ton Goodman, 36" gauge
1—5 ton Jeffrey, 36" gauge
2—5 to nJeffrey, 42" gauge
1—6 ton Goodman, 36" gauge
1—6 ton Goodman, 42" gauge
2—8 ton Goodman, 42" gauge
3—10 ton Jeffrey, 42" gauge
1—13 ton Goodman, 42" gauge
1—13 ton Jeffrey, 42" gauge
3—15 ton Jeffrey, 42" gauge

FILTERS
2—2' x 4' Morse drum filters
1—4' x 8' Elmco drum filter
1—4' x 2' disc Denver Leaf Filter
1—6' x 3' disc Oliver Leaf Filter
1—6' x 3' disc American leaf filter
1—18" Morse round pattern filter press
1—36" Merrill triangular filter press
1—#12 Sweetland filter press

SLUSHER HOISTS
1—Joy 15 h.p. double drum slusher Model AF-212
1—Joy 15 h.p. double drum slusher Model AAF-212
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1—Sullivan 2 drum slusher Model HD-10-B, gas engine driven

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1—10 HP Vulcan #0 Single Drum
1—15 HP Box Single Drum
1—20 HP H&B Single Drum
1—22 HP Vulcan Single Drum #1½
1—30 HP Vulcan Double Drum
1—30 HP Vulcan Single Drum
1—37 HP Single Drum
2—52 HP Vulcan #4½ Single Drum
1—50 HP Fairbanks-Morse Single Drum
1—60 HP Vulcan #23 ELF Single Drum
4—100 HP Box Single Drum
2—112 HP Vulcan Single Drum
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2—150 HP Vulcan Single Drum
1—22 HP Vulcan #1½ Double Drum
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1—Gardner-Denver Model HM

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4—2¼" x 3½" New Morse Lab Jaw Crushers
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COMPRESSORS
1—34 cfm Gardner-Denver Type ACM
1—44 CFM Ingersoll-Rand
2—88 CFM Ingersoll-Rand
1—179 CFM Ingersoll-Rand
2—190 cfm Chicago-Pneumatic Model PB2
1—198 cfm Sullivan Model WL60
1—447 CFM Ingersoll-Rand
1—445 cfm Worthington Model VA2
1—637 CFM Sullivan
1—698 CFM Union
1—800 CFM Ingersoll-Rand

BALL AND ROD MILLS
1—4" x 4" Marcy Ball Mill
1—6' x 48" Hardinge Conical Ball Mill
1—8' x 22" Hardinge Conical Pebble Mill
1—5' x 8' Marcy Rod Mill

CLASSIFIERS
1—3'8" x 18'4" Dorr Simplex
1—2'3" x 14'8" Denver Simplex
1—48" x 16" Akins Simplex

FLOTATION MACHINES
1—Fagergren Single Cell Type SDT
1—Morse Jet-Air New Hydrocell #7
1—4 cell Denver "Sub-A" #12
1—8 cell Denver "Sub-A" #12
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Modern Power Plant 2500 KVA GE Turbine Generator 3/60-2300/4160 volt, 400# 750° FTT, complete with boiler, superheater, economizer, condenser, boiler feed pump, feed water heater Hagan Combustion Control.

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Two practically new electrically heated 4' x 10' Hum-mer vibrating screens now operating in Youngstown, Ohio. 25KW Buda diesel generator set, 220/3/60, 1200 RPM, excellent condition, located at Chicago.

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DORR CLASSIFIER AND WASHER: 12' x 30' x 2½', quadruplex wood tank, with 20 H.P. motor, condition excellent.
DORR TROMMEL: 5' to 6' dia., 10'6" long, with motor.
SCREENS: Allis Chalmers Low Head 3' x 12' and 4' x 12', single deck. Tyler Tyrock F600, single deck, 3' x 12'. Hummer 3' x 10' single deck.
DENSIFIER: Wemco 48" x 27'3" complete, new, unused.
FLOTATION EQUIPMENT complete, including pulp sampler and distributor, mineral jigs, 6 cell flotation machines, super charger, agitator, 4" concentrate pumps, reagent distributors, etc. Used only 300 hours.
BALL MILLS: One 9'6" x 11 ft., NEW. Two Allis Chalmers 5 ft. x 22 ft. Tube Mills with steel heads.
PAN CONVEYOR: Heavy duty 48" x 110 ft., 100 H.P. motor, 440 volt, with speed reducer and drive.
PAN FEEDERS: Heavy duty manganese 60" x 14 ft., 20 H.P. motor, 220/440 volt, with speed reducer. NEW condition. Link belt 36" x 10 ft. with motor and reducer.
JAW CRUSHERS: 10 x 20, 15 x 36, 18 x 30, 24 x 36, 30 x 42, 42 x 40, with or without motors.
REDUCTION CRUSHER: Symons 2 ft., standard bowl.
DRYERS: 2—Ruggles Coles XA18, 104" x 70 ft., double shell, with 60 H.P. motor, speed reducer, exhauster, etc., suitable for use as kilns. Available 90 days. One 6' x 60 ft. complete with auxiliary equipment.
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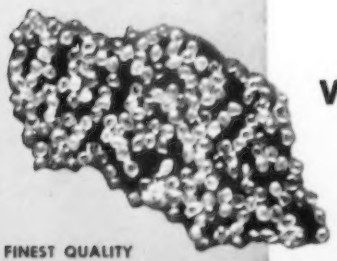

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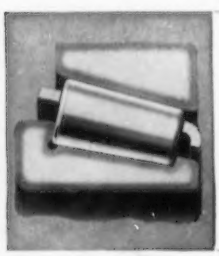

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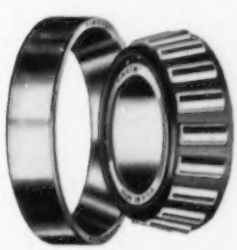

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